MOTOROLA

MINITOR II
Alert Monitor Receiver
Alerting Systems
R4-2-51A

SYSTEM PLANNER

MP MASTER
MA29564

PREFACE

MINITOR Alert Monitor Receivers have traditionally been used in public safety radio systems to alert firemen and other emergency personnel. The additional monitoring feature makes the unit unique compared to other Motorola voice pagers. In addition to public safety systems, MINITOR II Alert Monitor Receivers can be used in any radio system that requires channel monitoring capability in addition to tone and voice alerting. MINITOR II Alert Monitor Receivers, the second generation of Motorola belt-worn Alert Monitor Receivers, provide many enhancements over the first generation MINITOR Alert Monitor Receivers.

	MINITOR II Alert Monitor Receiver	MINITOR Alert Monitor Receiver
1.	Two Frequency Capability	One Frequency Capability
2.	Audible & Visual Alerting	Only Audible Alerting
3.	Low Battery Alert	Not Available
4.	Compliant with MIL SPEC 810D, Procedure II for Rain	Not Available
5.	Audio: 93 dB SPL-Alert 90 dB SPL-Audio	83 dB SPL-Alert 83 dB SPL-Audio
6.	Four Call Maximum with All Call and Subgroups	Two Call Maximum with One Group Call
7.	Large Rotary Controls for Operation w/gloves	Standard Controls
8.	On/Off Duty Option	SP Model
9.	Active Filters in All Alerting Models	Mechanical Reeds in Some Models
10.	Chargers and Charger Amps with Alert Lights	Alert Lights Not Available
11.	Vehicular Charger Amp	Not Available
12.	Charger Amp w/Relay	Not Available

In addition, the MINITOR II Alert Monitor Receivers are smaller, lighter, and more reliable than the original MINITOR Alert Monitor Receivers. Even the carrying cases have been improved for easier receiver control access and operation with gloves. For details on features and options refer to Section III.

The MINITOR II Alert Monitor Receivers use the same Two Tone Sequential Signalling as the original MINITOR Receivers and will drop into existing systems with the original MINITOR Receivers. The enhanced call capability provides greater alerting flexibility with greater group sizes and an all call with subgroups without changing the encoder (assuming the encoder is capable of the Motorola single long tone group call). Coding and grouping is discussed further in Section IV and APPENDIX A provides details on the encoding methods and code assignments.

With two frequency capability, it is possible to interface VHF and UHF MINITOR II Alert Monitor Receivers with trunked radio systems. This is accomplished by using PAC*TL or PAC*TR vehicular repeaters. Details on this concept can be found in Section V.

Finally, System Composition is addressed in Section VI and an equipment list is provided in Section VII.

I. INTRODUCTION

The purpose of a radio paging and/or alerting system is to transmit information to an individual or group of individuals who may be at various locations within a defined coverage area. These individuals carry radio receivers which allow them to receive the messages intended for them. Ideally, the individual user will choose a type of receiver which permits him to hear any message he wants or needs to hear without being distracted by transmissions which are irrelevant to him.

This document discusses LB, High Band and UHF radio alerting and monitoring systems. However, only selective call systems using manual (push-button) encoders are discussed in this document. Systems using automatic dial-up paging terminals are discussed in detail in SYS R4-1-83, R0-40-02, and other related system planners.

II. BASIC TYPE OF RADIO ALERTING SYSTEMS

A radio alerting system is essentially a one way radio communications system. The information path through the system runs from a centralized location outward to a number of remotely located receivers. These receivers may be fixed, portable, or mobile in nature.

There are two basic types of radio alerting systems. In a constant monitor alerting system, carrier squelch or tone coded squelch (Motorola Private-Line squelch) monitor receivers, continously listen for the presence of radio traffic on the channel. The carrier squelch receivers will receive all traffic on the frequency regardless of its origin or nature. While carrier squelch constant monitor alerting systems may be desirable in situations where a continuous flow of information is required, as a pure alerting system they are less than optimum in that the user must

"pick" his alarm out of a random stream of channel traffic. Unless the user is paying careful attention to what is being said over the radio, it is possible for his alarm to come and go completely unnoticed.

Tone coded squelch (Private-Line squelch) receivers are similar to carrier squelch receivers in that they too listen continuously for traffic on the radio channel. Because their squelch is tone coded, however, they will hear only those transmissions accompanied by the proper sub-audible coded tone. This means that on a shared radio channel, the listener need not be bothered by all of the traffic present on the frequency. The receiver will pick out only those transmissions from within his own PL system.

Figure 1 shows a constant monitor alerting system in its simplest form. The carrier squelch variety (See Fig. 1) utilizes a carrier squelch base station with carrier squelch receivers. The tone coded squelch variety uses a tone coded squelch (Private-Line squelch) base station and complementary receivers.

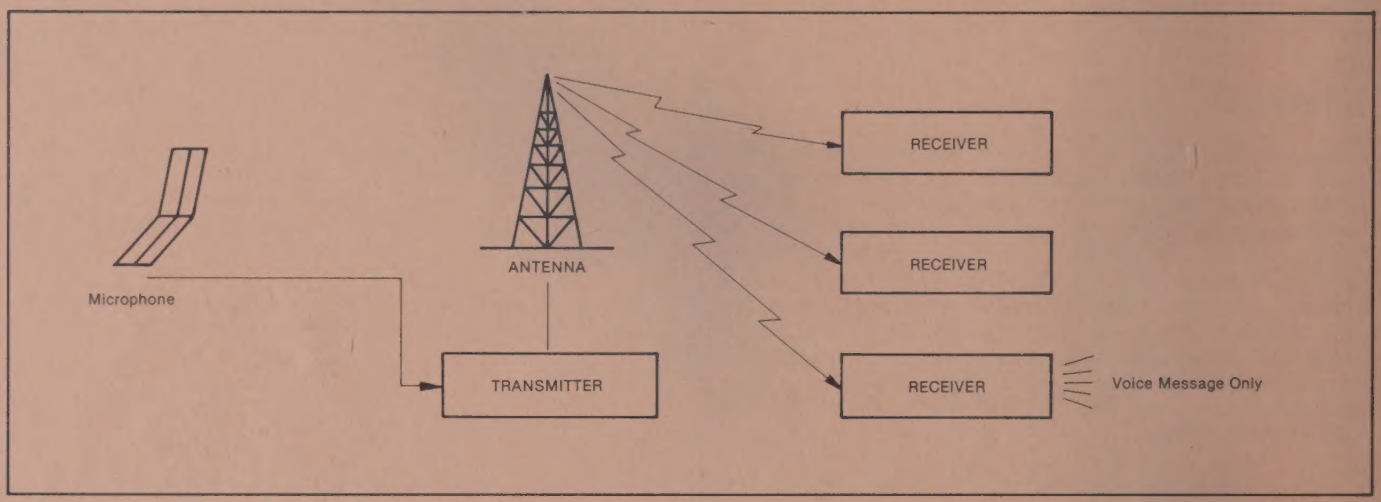


Fig. 1. Basic Constant Monitor Alerting System

The second basic type of radio alerting system is a selective call system (See Fig. 2). This system in its simplest form, consists of an encoder, a transmitter, an antenna and one or more remotely located receivers. Upon activation, the encoder generates and sends to the transmitter an audio frequency tone code. Each receiver in the system contains a decoder which responds to a particular tone code. When the correct code for one or more of the receivers is transmitted, the appropriate receiver(s) will be activated, emitting an audible "beep" tone to alert the listener. Following the alert, the receiver squelch opens and allows the user to receive a voice message.

A selective call system is particularly desirable for alerting applications because receivers in the system are silent until an alarm or alert is sent. The user isn't lulled into inattention by a random stream of traffic on the channel. He can go about his business without being bothered by a "chattering" receiver, knowing full well that in the event of an alarm, his alert tone will warn him of an impending message. Figure 2 illustrates the layout of a basic selective call alerting system.

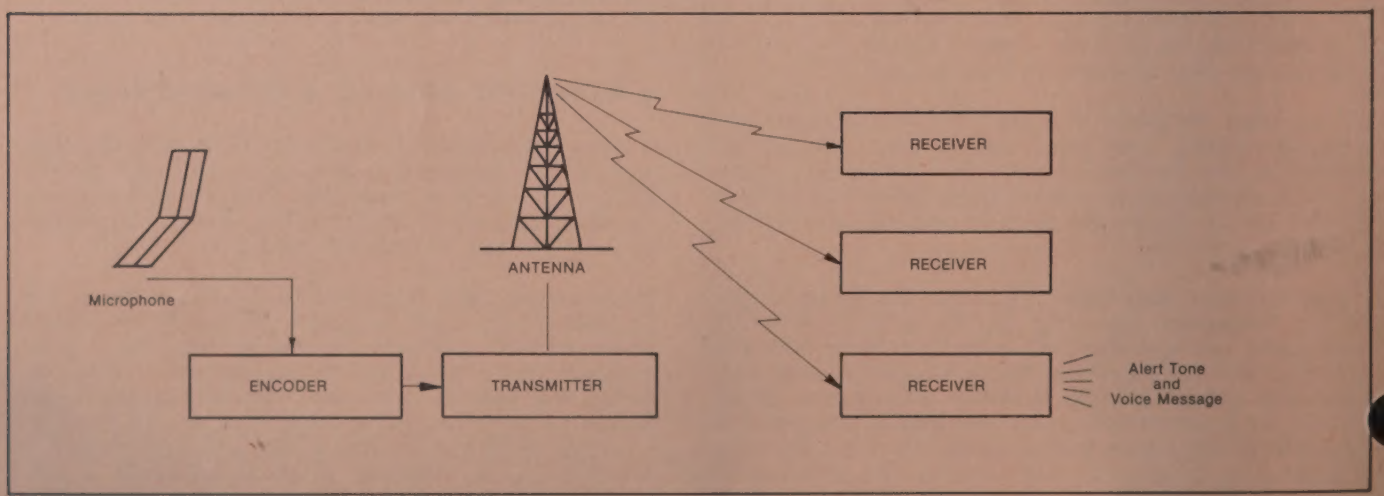


Fig. 2. Basic Selective Call Alerting System

III. "MINITOR II" ALERT MONITOR RECEIVERS

The MINITOR II Alert Monitor Receiver is designed specifically for use in radio alerting and/or radio channel monitoring applications. These receivers are truly portable. They can be worn on the belt, carried in a pocket, or in some other convenient manner. MINITOR II Alert Monitor Receivers are available in Low Band (30-50 MHz), High Band (132-174 MHz), and UHF (403-430, 450-512 MHz) bands.

Private Paging Marketing should be contacted concerning use of any frequency other than those listed. For complete electrical and mechanical specifications, consult the appropriate catalog sheets or Detailed Technical Specifications, R16-5-18. MINITOR II Alert Monitor Receivers operate on one or two frequencies. Frequency one provides alerting and/or monitoring capability. Frequency two does *not* provide any alerting capability — only monitoring is possible on frequency two.

III.A. Selective-Call Two-Tone Sequential MINITOR II Alert Monitor Receiver Operation

The Selective-Call MINITOR II Alert Monitor Receiver operating on frequency one in the alert mode combines the functions of a paging receiver and a Carrier-Squelch monitor receiver. Like a paging receiver, the Selective-Call model remains muted until the proper two-tone sequential code or single long tone code is received. The user then hears a high-pitched, alert tone. After the alert for frequency one ends, the receiver automatically switches to the Carrier-Squelch mode of operation. The user hears all the transmissions on this channel until he manually resets the MINITOR II Alert Monitor Receiver to the "Alert" mode by depressing and releasing the reset button on top of the receiver.

The user may at any time manually switch to the carrier-squelch mode of operation using the function switch on top of the receiver. This allows him to continuously monitor channel traffic. It is important to note that even when the MINITOR II Alert Monitor Receiver is operating in the carrier-squelch mode on frequency one, the user will receive an alert tone whenever his code is received. For two frequency units, the user can switch manually to a second frequency. Frequency two provides only monitoring capability and will **not** provide any alerting capability. The primary application for this second frequency is to provide monitoring of fireground operations and free up frequency one for additional dispatching information.

The call or calls to which the MINITOR II Alert Monitor Receiver will respond is determined by two or three plug-in solid state active filters. Each active filter corresponds to a particular tone in Hertz (Hz). These active filters are defined as A,B, and C respectively for the first, second and third active filter tones installed in a particular unit. The active filters are available on specific frequencies in the 288.5 Hz to 3062.0 Hz range. Appendix A contains a summary of the specific tone frequencies on which MINITOR II Alert Monitor Receiver active filters can be ordered. Also shown are the various Motorola and competitive code plans that utilize these tones. For availability of tone frequencies not appearing in Appendix A please contact Private Paging Marketing, Boynton Beach, Florida. The Selective Call MINITOR II Alert Monitor Receiver is available with up to four calls. (See page 5 for the call configurations available.)

Unless otherwise instructed on the order write-up, the plant will assign all coding to selective call MINITOR II Alert Monitor orders. If your customer requires specific codes, you must specify the required active filter tone codes on your order write-up (See Appendix A, Table 3 — Tone Groups). When selling MINITOR II Alert Monitors into any competitive system using a competitive encoder, you must specify the actual tone frequency in Hz.

III.B. MINITOR II ALERT MONITOR RECEIVER SELECTIVE CALL STANDARD MODELS

The Selective-Call MINITOR II Alert Monitor Receivers have an On/Off-volume control, LED for visual alerting and low battery indication, code label window, function (alert/monitor) switch, and external speaker jack. The battery compartment door is on the side of the receiver. The receiver is equipped with a belt clip to secure the radio to the user's belt. MINITOR II Alert Monitor Receiver Selective Call model standard features include the following:

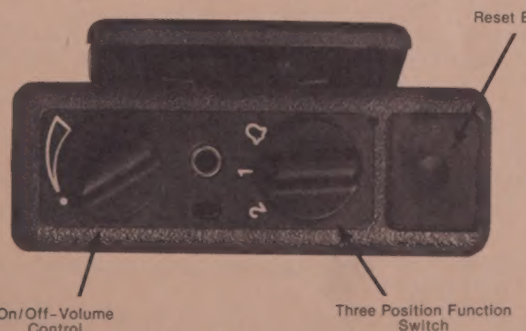
1. *Two Frequency Operation* — All standard MINITOR II Alert Monitor Receivers provide two frequency operation. The limit for the separation between the two frequencies varies for the different bands as follows.

LB - 4 MHz
High Band - 3 MHz
UHF - 5 MHz

In addition, the two frequencies must fall within the various bandsplits of the receiver boards within each band.

LOW BAND	HIGH BAND	UHF
30.00-32.99MHz	132.00-139.99MHz	403.00-419.99MHz
33.00-36.99MHz	140.00-147.99MHz	420.00-430.00MHz
37.00-40.99MHz	148.00-159.99MHz	450.00-469.99MHz
41.00-44.99MHz	160.00-174.00MHz	470.00-487.99MHz
45.00-50.00MHz		488.00-512.00MHz

2. *Alert/Monitor Switch* — The function (alert/monitor) switch allows the user to manually control the operation of the receiver. When in the alert mode (🔔), the receiver will only respond when the user's specific call code is received on frequency one. When in the monitor frequency one mode (1), the unit will receive all communications on frequency one plus audible and visual alerts for the user's specific codes on frequency one. When in the monitor frequency two mode (2), the user will receive all the communications on frequency two, but will not receive any alerts. If the radio is ordered with Delete Second Frequency option (R521), the monitor frequency two positon will be strapped to the monitor frequency one position — frequency one calls, alerts and communications will be received whether the switch is in position 1 or 2.



MINITOR II TOP ESCUTCHEON

3. *Tone and Visual Alerting* — The MINITOR II Alert Monitor Receiver provides both tone and visual alerting. In addition to the audible alert tone, an LED flashes in unison with the audible alert (with EIA tone timing only).

4. *Automatic Low Battery Alert* — MINITOR II Alert Monitors provide an automatic audible and visual low battery alert. When the battery reaches a level of 2.2 volts (down from the normal voltage of 2.6 volts), an 850 millisecond audible warble alert is generated. The LED on top of the pager also illuminates in unison with the audible tone. After the initial low battery alert, the audible indication is repeated after any alerts or audio, until the battery is recharged or replaced. The LED will continue to flash until the battery is replaced or recharged. If the battery is left in the unit and recharged, the reset button must be depressed to reset the visual low battery indication (meets National Fire Protection Association (NFPA) Standard 1221, Section 3-11.3.6).

5. *Military Standard 810D Procedure II for Rain* — MINITOR II Alert Monitors meet MIL SPEC 810D, Procedure II for Rain. The speaker grille cloth is treated and the battery door, top cover, and bottom contacts are all gasketed to prevent entry of moisture or water according to the Military Standard (meets NFPA Standard 1221, Section 3-11.3.2).

6. *Superb Audio Output* — The audio output is at 93 dB SPL @ 12" for the alert tone and 90 dB SPL @ 12" for audio. This audio output is sufficient in many high noise environments and surpasses competitive units in the 83-85 dB SPL range.

7. *Large Rotary Controls* — MINITOR II Alert Monitor controls have been human engineered to facilitate operation with gloves (meets NFPA Standard 1221 Section 3-11.3.4).

8. *Variable Volume Control* — Unlike some competitive alert monitor receivers which have a high-low two position volume control, MINITOR II Alert Monitor Receivers have a volume control that covers the entire volume range, thereby providing volume settings to accommodate a variety of ambient noise environments. However, the MINIMUM volume setting will allow audio at a very low volume to come through. In other words, the only "no-volume" setting is with the receiver off.

9. *Speaker Jack* — MINITOR II Alert Monitor Receivers include a speaker jack on the top of the unit to provide operation with a variety of audio accessories including Helmet Liner Headsets, XL (extra loud) Lapel Speakers, and Earpieces. These audio accessories are particularly beneficial for two frequency units that in many cases will provide monitoring of fireground operations where the noise levels will be exceptionally high.

NOTE: Audio Accessories are not recommended when OPTION R144, Fixed Alert/VARIABLE AUDIO is ordered. See Section IIIC.3.

10. *Internal Squelch Adjustment* — The squelch is preset in the factory before the unit ships. If necessary, the squelch pot on the decoder board can be easily adjusted by a qualified service technician.

III.C. MINITOR II SELECTIVE CALL MODEL OPTIONS

MINITOR II Selective Call Alert Monitor Receivers are available with the following options.

1. DELETE SECOND FREQUENCY (R521) — When this option is ordered, the first oscillator crystal for frequency two and one warp coil is omitted. At any time these components can be added at one of the Motorola Warranty Depots to provide two frequency operation. When this option is ordered, the monitor frequency two position on the function control switch is strapped to monitor frequency one position.

2. CALL OPTIONS — There are 9 different call or code configurations available on MINITOR II Alert Monitor Receivers. Standard models are equipped with one two tone sequential call, (A-B). Up to four calls can be ordered. The eight options for various call configurations are listed on the following page (pg. 5). See appendix table 9 for alert option tone sets.

3. ALERT ON SECOND FREQUENCY (R239) — This option allows the user to receive an alert on frequency two, while monitoring the channel, when the message is transmitted on frequency two. The same call options and codes for frequency one will cause an alert on frequency two.

4. FIXED ALERT/VARIABLE AUDIO (R144) — This option fixes the alert tone volume at the maximum level, but voice audio is still controlled by the volume control. This option is useful when the user moves in and out of different noise environments and might inadvertantly set the volume level of the alert tone too low. **When using audio accessories such as the XL Lapel Speaker, Earpiece, or Helmet Liner Headsets, this option is *not* recommended.**

5. ON/OFF DUTY (R469) — This option provides the capability to turn off one or two of the calls depending upon which call option is ordered with the radio. This is accomplished by using the function switch on top of the radio. The C Tone in the pager is disabled in the off duty position thereby turning off any call that includes a C tone. **The on/off duty option is not compatible with standard two frequency models. Therefore, the R521 (Delete Frequency Second) option must be ordered. It is also not compatible with the standard call configuration (A-B) or the R138 (A-B, Long Tone B) option.**

The following chart outlines which calls are active when in the on and off duty positions for the various call configurations. Remember, the R469 option must be ordered in conjunction with the call option listed.

ON/OFF DUTY ACTIVE CALLS

OPTION	ON DUTY	OFF DUTY
R97	A-B A-C	A-B
R177	A-B C-B	A-B
R362	A-B Long C	A-B
R130	A-B A-C Long C	A-B
R60	A-B C-B Long B	A-B Long B
R134	A-B Long B Long C	A-B Long B
R468	A-B A-C Long B Long C	A-B Long B

Customer Requirement	Option Required	Call Format	Tones Req. Per Receiver	Special Note and System Limitations
One call used by an individual or several individuals in one group with all units coded the same	None Std. Model	A-B	2	Standard Two Tone.
Two Calls in one the of the following situations. 1. Two individual calls 2. One individual and one group call 3. Two group calls	R97	A-B A-C	3	Standard Two Tone. Motorola Common Tone A. Used in Plectron Systems. **System:** Group call is required, but encoder is not capable of a single long tone.
Two Calls in one of the following situations. 1. Two individual calls 2. One individual call and one group call 3. Two groups calls	R177	A-B C-B	3	Standard Two Tone. Common Tone B. Used in Plectron Systems. Can be used in conjunction with Common Tone A to expand the maximum number of individuals per group. **System:** Group call is required, but encoder is not capable of a single long tone.
Two Calls One individual call and one group call. (Note 1)	R138	A-B Long Tone B*	2	Standard Two Tone. Use in Motorola systems and some competitive systems. **System:** Encoder must be capable of single long tone.
Two Calls Requirements for one all call group call with large number of individuals in the group.	R362	A-B Long Tone C*	3	**System:** Encoder must be capable of single long tone. Alert Central encoder will **not** provide Long Tone C.
Three Calls 1. Two individual calls and one group call. 2. One individual call and two group calls.	R130	A-B A-C Long Tone C*	3	**System:** Encoder must be capable of single long tone. Alert Central encoder will **not** provide Long Tone C.
Three Calls 1. Two individual calls and one group call. 2. One individual call and two group calls.	R60	A-B C-B Long Tone B*		Standard Two Tone. Common Tone B used in Plectron Systems. **System:** Encoder must be capable of single long tone.
Three Calls One individual call, one limited size subgroup, and one all call group.	R134	A-B Long Tone B* Long Tone C*	3	**System:** Encoder must be capable of single long tone. Alert Central will **not** provide single long tone C.
Four Calls One individual call, Three group calls	R468	A-B A-C Long Tone B* Long Tone C*	3	**System:** Encoder must be capable of single long tone. Alert Central encoder will **not** provide single long tone C.

See TABLE 9 on page 26 for a description of the audible alerts provided by the MINITOR II Alert Monitor Receiver.

*NOTE: Long Tone B and Long Tone C limited by the number of tones in the encoder. See Tables 5-8 on pgs. 25-27 for maximum capabilities.

With the On/Off Duty Switch option, the positions and operation are as follows:

ALERT (ON DUTY)

ALERT (OFF DUTY)

MONITOR

5. COLORED HOUSING OPTIONS (R139-WHITE, R140-RED) Standard models are equipped with a shadow bronze housing. The options listed above will provide an optional red or white housing.

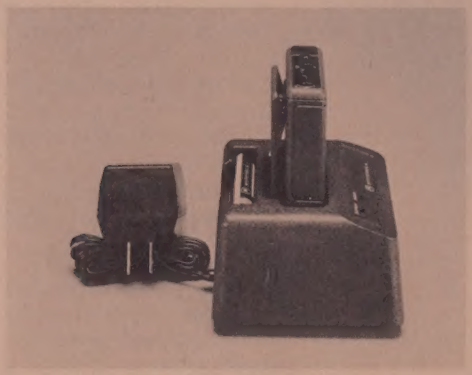
III.D. MINITOR II ALERT MONITOR RECEIVER CHARGERS

There is a broad range of chargers available for MINITOR II Alert Monitor Receivers.

Single Unit Charger

NRN4952-110V
NRN4953-220V

This unit provides charging capability for one spare battery and the battery installed in the MINITOR II Alert Monitor Receiver.



Single Unit Charger with Alert Light, Reset Button, and Antenna

NLN3045-110V
NLN3046-220V

This unit provides the same capability as the single unit, but also has an alert light which is illuminated during alerts while the unit is in the charger. The alert light remains illuminated until the user manually depresses the reset button on the charger. This allows the user to have an indication that he was alerted while the MINITOR II Alert Monitor Receiver was left unattended and in the charger. For fire alerting or other manual dispatch applications, the user can then call the dispatcher to receive the missed information. This charger also has an antenna to provide extended reception in fringe areas. When the monitor is placed in the charger, connection to the antenna and alert light occurs automatically.

Charger Amplifier

NLN 3039 - 110V
NLN3040 - 220V

This unit provides all of the capabilities of the Single Unit Charger with Alert Light, Reset Button, and Antenna; but also includes a 2.5 Watt audio amplifier and one external speaker connection. When an external speaker is used, the internal speaker is muted. The Charger Amp is excellent for applications that require extra loud audio in high noise environments. This unit can also be used to wake firemen for late night or early morning alarms. The antenna provides extended reception beyond the standard receiver antenna. When the monitor is placed in the charger amp, connection to the charger antenna, amplifier speaker, and alert light occurs automatically. There is also a "night light" inside the charger pocket to facilitate insertion of the receiver under poor lighting conditions.

Vehicular Charger Amplifier (12VDC).

NLN 3043 - Vehicular Charger Amp without Relay
NLN 3044 - Vehicular Charger Amp with Relay

This unit is the same as above, but also includes vehicular mounting hardware, power cord, and an antenna adaptor cable to provide connection to a Motorola mobile antenna. Charger Amp with relay operation is discussed on page 7, under the heading "Charger Amp and Vehicular Charger Amp with Relay."

NOTE: The vehicular charger amp should be wired so that power is supplied to the unit only when the vehicle is on. Otherwise, the night light in the charger amp will always be on and possibly drain the vehicle battery.

Charger Amplifier Locking Mechanism

NRN5030

This device attaches to the charger amp and locks the MINITOR II Alert Monitor Receiver into the charger amp with a lock and key. This device provides protection when a vehicle is left unattended with a receiver in the charger amplifier.

Cigarette Lighter Adaptor Power Cord

NRN5031

A coiled power cord with a cigarette lighter adaptor is available as a separate item. This may be used in place of the standard power cord supplied with the vehicular charger amplifier when hardwiring the 12 VDC power cord is not desirable. However, if the cigarette adaptor is always left in, the pocket light will be constantly illuminated and may run the car battery down over an extended period of time.

Charger Amp and Vehicular Charger Amp with Relay

Charger Amp with Relay-110V NLN3041
Charger Amp with Relay-220V NLN3042
Vehicular Charger Amp without Relay NLN3043
Vehicular Charger Amp with Relay NLN3044

These units are equipped with relays to provide control of external equipment. The relay in the charger amp is limited to 750 mA and should requirements go beyond that, an additional power relay will be necessary to handle the increased current. The relay can be configured as continuous or timeout. With the continuous relay, the relay remains latched and the alert light illuminated until the reset button on the charger amp is depressed. With timeout, the relay remains latched for 10 seconds (following the beginning of the alert tone) then automatically opens up. The alert light still remains illuminated until the reset button is manually reset. The charger amps with relay are always configured for timeout, but can be reconfigured as a continous relay by inserting a jumper on the DIN connector on the back of the charger amp.

These units equipped with relays (and an additional power relay) can be used to open a fire house garage door, turn on a light, or activate other equipment.

NOTE: The vehicular charger amp w/relay, and a DIRECTOR II Radio Pager with auto reset can be used in place of the desktop Alert Monitor (CNB Series) for permanent installations and applications that require a relay. The vehicular mounting hardware can be used to permanently install the unit in a rack or on a bench. Since the Vehicular Charger Amp does not include an AC power cord with transformer, a transformer must be ordered in addition to the vehicular charger amp w/relay. The vehicular locking kit is also recommended for this type of application.

1. **Vehicular Charger Amp with Relay .... NLN 3044 (includes mounting hardware)**
2. **Locking Kit NRN5030**
3. **Transformer**
   110V NRN4987
   220V NRN4988

III.E. "MINITOR II Alert Monitor Receiver" Battery Life

All models within the MINITOR II Alert Monitor Receiver product line can be used with two different types of batteries. One type is a "dual N-cell" 2.6 V dc rechargeable nickel-cadmium battery. The other type is a 1.4 V dc non-rechargeable mercury battery. Each MINITOR II receiver uses one dual N-Cell nickel cadmium battery or two standard N-cell mercury batteries.

Keep in mind the MINITOR II Alert Monitor Receiver is more than a pager. It is a monitor receiver as well. Battery life on a pager can be spec'ed fairly easily, simply by estimating the number of calls of a specified length received per day. With the MINITOR II Alert Monitor Receiver, the situation is compounded by the fact that the user can simply monitor the channel as much as he wishes. Since the radio draws 200 mA of power in the receive mode compared to 6 mA of power at standby, the battery life becomes dependent on the amount of traffic on the channel; the busier the channel, the quicker the batteries will be expended.

Battery life in the various models of the MINITOR II Alert Monitor Receiver is dependent on the total amount of operating time and the proportion of that time spent in the alert (stand-by waiting for an alert) and monitor (receiving a message at rated audio output) modes. For example, a MINITOR II alert monitor tuned to an RF channel which is active 5% of the time will have a 5% "receive duty cycle." It will be receiving a signal and delivering audio power to the speaker 5% of the time it is operating. It will be in the stand-by mode 95% of that time.

The selective call MINITOR II Alert Monitor Receiver when used solely in the alert mode, can be expected to provide battery life comparable to a pager. To compare expected battery lives for typical systems, please refer to the following chart. You can expect a typical fire alerting **only** channel to have a 2% duty cycle while a typical police channel will have 10% duty cycle.

MINITOR II Alert Monitor Receivers (or any similar receiver) use more power while in the receive mode than in the stand-by mode. Hence, the less time spent in the receive mode, the longer the battery will last. Tables A and B show MINITOR II battery life (in hours of operation) for selective call operation versus 2 and 10% duty cycles. Tables include battery life in hours for NI-Cd and mercury batteries.

TABLE A

	LB		VHF		UHF	
	Mercury	Ni-Cd	Mercury	Ni-Cd	Mercury	Ni-Cd
Selective Call Mode	135	29	135	29	127	26

TABLE B

	LB		VHF		UHF	
	Mercury	Ni-Cd	Mercury	Ni-Cd	Mercury	Ni-Cd
Monitor Mode 2% Duty Cycle	92 Hrs.	19 Hrs.	92 Hrs.	19 Hrs.	89 Hrs.	19 Hrs.
10% Duty Cycle	34 Hrs.	7 Hrs.	34 Hrs.	7 Hrs.	34 Hrs.	7 Hrs.

IV. "MINITOR II" ALERT MONITOR RECEIVER SIGNALLING

IV.A. Motorola Two-Tone Sequential Systems.

1. Receivers

MINITOR II Alert Monitor Receivers use the same two-tone sequential signalling format used by the original MINITOR Alert Monitor Receiver and many other Motorola tone and voice radio pagers.

As indicated in an earlier section, selective call MINITOR II Alert Monitor Receiver models are designed to be signalled (alerted) by the proper sequence of two audio frequency tones in the range of 288.5 Hz to 3062.0 Hz. In order for this to be accomplished with maximum reliability:

a. The tone frequencies being generated by the encoder must be accurate with 0.5% of the nominal value.

b. Tone A (the first tone of the sequence) must be sent by the encoder for a duration of 1 second, and Tone B (the second tone of the sequence) must be sent by the encoder for a duration of 3 seconds.

c. No intertone gap ("space" or time left open by the encoder between the transmission of Tone A and Tone B) should be present.

Figure 3 is a graphic illustration of this recommended signalling sequence.

NOTE: The above 3 factors are considered necessary for optimum signalling efficiency. In specific situations, such as interfacing into competitive systems using shorter tone timing, the Minitor II will operate with tone timing reduced to 750 Milliseconds for Tone A and 750 Milliseconds for Tone B. The fast Plectron signalling using 0.75 seconds for the first tone and 0.25 seconds for the second tone can also be used. This is possible because the Plectron coding scheme provides an alert tone that is transmitted after the tones are sent. For other competitive coding 0.75 seconds is required for the second tone to provide at least a brief internally generated alert tone in the MINITOR II Receiver. In these circumstances also, an intertone, gap of up to 250 milliseconds can be tolerated. As a general rule, however, when operating Minitor II in a competitive system from a competitive encoder, the closer the encoder can be modified to simulate the signalling format pictured in Figure 3, the better the Minitor II Alert Monitor Receivers will perform. In fact, even the competitor's monitor receivers used in that same system may benefit. See Section IV F for further details on interfacing MINITOR II Alert Monitor Receiver into existing competitive systems.

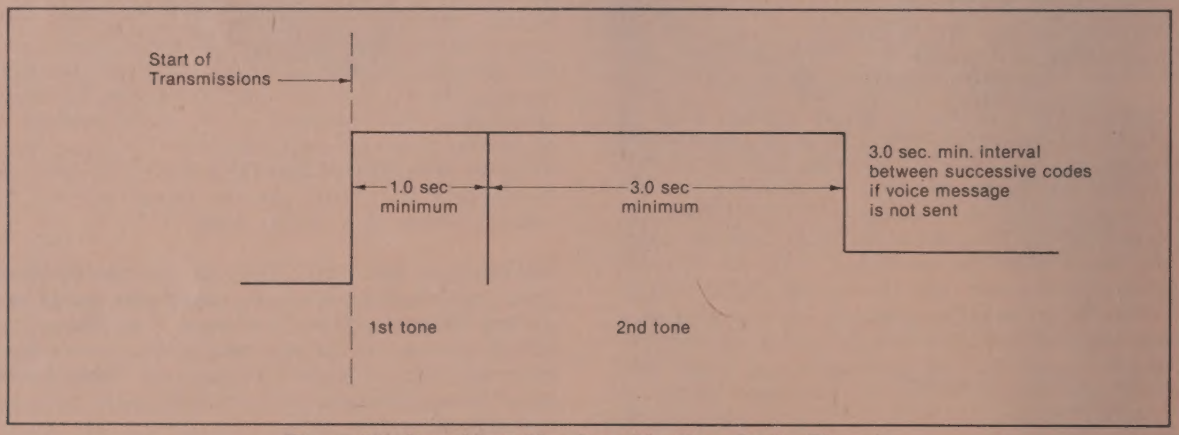


Fig. 3 Minitor Alert Monitor Alerting Code Signal

Selective call MINITOR II Alert Monitor Receivers equipped with Long Tone B or Long Tone C calls may be signalled with one tone. This is accomplished when the encoder transmits tone B or tone C for a period of 8 seconds.

Figure 4 graphically illustrates the Minitor II Alert Monitor Receiver long tone signalling format.

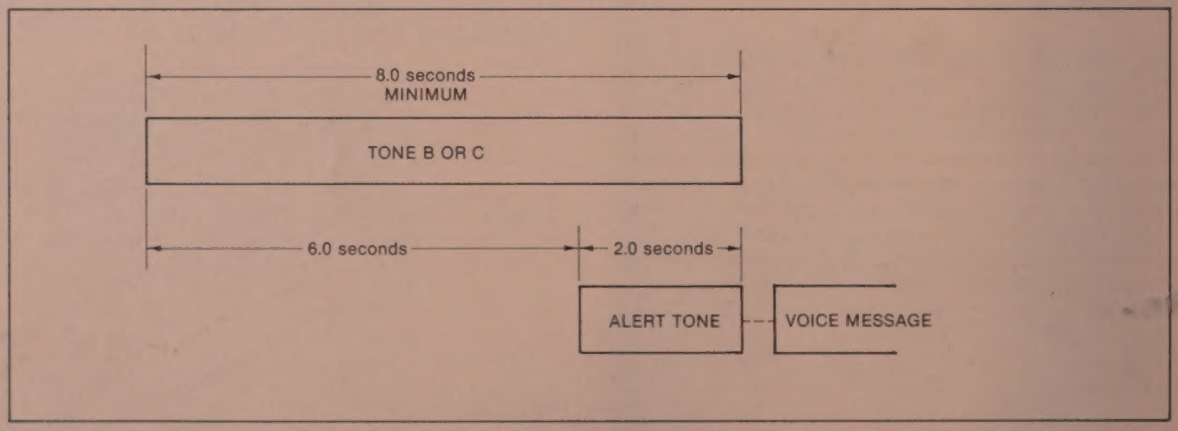


Fig. 4. Minitor II Alert Monitor Long Tone Group Call

NOTE: The group call signalling format described above is unique to Motorola. The same group call format is used for PAGEBOY III, DIRECTOR II, PAGECOM, MINITOR, Dimension IV, and Spirit pagers, hence, MINITOR II Alert Monitor Receivers with the R138 group call option interface perfectly with these systems. Many competitive systems, however, accomplish the group calling function in a different manner. See Section IV, F for further details on interfacing MINITOR II Alert Monitor Receivers into existing competitive systems.

2. Encoders

Encoders can be divided into two categories depending upon the way the codes are selected — pushbutton encoding and dial-interconnected encoding. The terms are self descriptive. On a push-button encoder, the operator manually selects the code of the radio he wants to call by pushing the appropriate buttons. In a dial-interconnect system, a radio is called by dialing its code number on a telephone. The system can be arranged so that the radios can be called from any telephone within the PBX system, or with the PSTN, public switched telephone network, if the system is properly interconnected (See SYS R4-1-83 and RO-40-02). This MINITOR II System Planner deals solely with manually encoded systems. Additional information on manual encoders (Alert Central, MODEN 36, and MODEN 100) can be found in R4-1-66.

Motorola Manual Paging Encoders such as the E08ENC series, PEOPLE FINDER and MODEN Encoders series meet all tone stability and timing requirements for MINITOR II Alert Monitor Receivers as well as for all Motorola tone and voice radio pagers. These units generate the two-tone sequential codes that alert a specific individual or group. The sequence and duration of the tones are automatically controlled by the encoder once the specific code has been selected by the operator. All of the Moden encoders use state-of-the-art digital synthesizers.

All Motorola two-tone codes that can be sent by one encoder depends on the number of digits and the size of the memory installed.

If more than one radio is assigned the same code, all those radios will respond, as a group, to the same signal.

Because there are eighty audible alerting tones available for two tone alerting codes, up to 6320 valid codes are possible. Therefore, as your Motorola price pages point out, code assignments for a new system are made in Schaumburg. Keeping a central record of code assignments lets the plant coordinate the assignments to co-channel Motorola system users, reducing the possibility that one system will interfere with another on the same frequency when located in the same area.

Because records of systems are coordinated in the Coding Department in Schaumburg (1301 East Algonquin Rd., Room 4721), it is essential that the Coding Department be informed in writing of any field changes in radio frequency or codes of alerting receivers. In some customer circumstances, there may be no co-channel users or, RF channel changing may be a frequent occurrence. It then becomes necessary to provide the customer with information permitting him to keep records of his own codes and request specific code assignments on new radio orders.

Group Call

There are three types of group call available for MINITOR II Alert Monitor Receivers. Any of the three types will allow pagers to be alerted both individually and as one of a group.

Long Tone B and Long Tone C Group Call

Figure 4 illustrates one type of group call available for many Motorola tone and voice pagers. With this approach, the group call function is accomplished by the encoder transmitting only the pager's tone B (the second tone of the two-tone code) for a period of eight seconds. This single long tone B group call signalling is the same as the one used on Pageboy III, DIRECTOR II, MINITOR, Pagecom, Dimension IV and Spirit radio pagers. MINITOR II Alert Monitor Receivers can also provide a Long Tone C group call. This allows an expanded group call. A larger number of individuals can be assigned to one group (compared to Long Tone B Group Call). All current Motorola encoders (with the exception of the Alert Central — no Long Tone C) are capable of encoding either of these single long tone group calls for MINITOR II Alert Monitor Receivers equipped with the appropriate option. The number of groups and group size is determined by the number of tones or tone synthesizers in the encoder. Potential system size should be considered when determing the initial capacity of the encoder to be ordered.

1. Long Tone B Group Call

The number of possible groups is equal to the number of tones or tone synthesizers in the encoder. For example, a ten-tone encoder (90-call) can have a maximum of ten groups. Long Tone B group call assignments are derived in the following manner.

1. All receivers in the Long Tone B group call are assigned the same B tone.
2. Individual calls are determined by two tones in sequence, A followed by B. The A tone cannot equal the B tone.
3. Once the common B is assigned to all receivers in the group, unique individual two tone sequential calls are created by assigning the remaining tones in the encoder as the A tone.

For Example: There are 10 tones available, tones labeled as 1-10. Tone 1 represents a particular frequency in Hz, Tone 2 represents a different frequency in Hz, etc.

INDIVIDUAL CALL		GROUP CALL
Tone A	Tone B	Tone B
1	10	10
2	10	10
3	10	10
4	10	10
5	10	10
6	10	10
7	10	10
8	10	10
9	10	10

This assignment procedure is then repeated, assigning each of the remaining tones to the "B" position. The following assignments for tone B would be 9,8,7,6 etc...and the individual calls would be created with the remaining tones as described above in step 3. Using all ten tones in the B position would provide 10 groups of 9 individuals.

2. Long Tone C group Call

For long tone C group call, the C tone is independent of the A/B tone combination for individual call, therefore, the number of individuals per group is greater. MINITOR II Alert Monitor Receivers utilizing the R134 option (A-B, long B, long C) can be coded to create an all call group with subgroups. The assignments are derived in the following manner.

1. All receivers in the Long Tone C group call are assigned the same C tone. This creates the all call group.
2. Individual calls are determined by two tones in sequence, A followed by B. Tone A cannot equal B or C.
3. Once the common C is assigned to all receivers in the group, the remaining tones in the encoder are

assigned as the A or B tone to create an expanded number of unique individual two tone calls.

4. Units that have a common B tone can be alerted as a separate or subgroup within the all call group.

For example: There are 10 tones available, tones labeled as 1-10. Tone 1 represents a particular frequency in Hz, Tone 2 represents a different frequency in Hz, etc.

	INDIVIDUAL CALL		SUBGROUPS Long Tone B	ALL CALL Long Tone C
	Tone A	Tone B	Tone B	Tone C
	1	9	9	10
	2	9	9	
	3	9	9	
	4	9	9	
SUBGROUP 9	5	9	9	
TONE A ≠ B ≠ C	6	9	9	
CANNOT USE A = 9 OR 10	7	9	9	
8 INDIVIDUAL CALLS	8	9	9	
	1	8	8	
	2	8	8	
	3	8	8	
	4	8	8	
SUBGROUP 8	5	8	8	
TONE A ≠ B ≠ C	6	8	8	
CANNOT USE A = 8 OR 10	7	8	8	
8 INDIVIDUAL CALLS	9	8	8	
SUBGROUP 7	1	7	7	
TONE A ≠ B ≠ C	↓	↓	↓	
CANNOT USE A = 7 OR 10	↓	↓	↓	
8 INDIVIDUAL CALLS	9	7	7	
SUBGROUP 6	1	6	6	
TONE A ≠ B ≠ C	↓	↓	↓	
CANNOT USE A = 6 OR 10	↓	↓	↓	
8 INDIVIDUAL CALLS	9	6	6	
SUBGROUP 5	1	5	5	
TONE A ≠ B ≠ C	↓	↓	↓	
CANNOT USE A = 5 OR 10	↓	↓	↓	
8 INDIVIDUAL CALLS	9	5	5	
SUBGROUP 4	1	4	4	
TONE A ≠ B ≠ C	↓	↓	↓	
CANNOT USE A = 4 OR 10	↓	↓	↓	
8 INDIVIDUAL CALLS	9	4	4	
SUBGROUP 3	1	3	3	
TONE A ≠ B ≠ C	↓	↓	↓	
CANNOT USE A = 3 OR 10	↓	↓	↓	
8 INDIVIDUAL CALLS	9	3	3	
SUBGROUP 2	1	2	2	
TONE A ≠ B ≠ C	↓	↓	↓	
CANNOT USE A = 2 OR 10	↓	↓	↓	
8 INDIVIDUAL CALLS	9	2	2	
SUBGROUP 1	2	1	1	
TONE A ≠ B ≠ C	↓	↓	↓	
CANNOT USE A = 1 OR 10	↓	↓	↓	
8 INDIVIDUAL CALLS	9	1	1	

ALL CALL
72 INDIVIDUALS (9x8)

By using the long tone C tone and long tone B group call, an expanded "all call" group of 72 individuals and 9 subgroups of 8 individuals is created (9 subgrops x 8 individuals = 72). This compares to the maximum group size of 9 individuals above for Long Tone B alone when the long tone C is not used. See pages 26 and 27, Tables 7 & 8 for maximum capabilities of each of the Motorola encoders.

Older encoders and terminals may require modifications to perform single-tone group call. SRN-543 contains the mofification on N1019A and L08ENC series encoders. If modifications to equipment not covered in SRN-543 are required, contact your Area Systems Engineer or Paging Systems Marketing.

3) Dual Call Group Call

The third group call format used only on MINITOR II Alert Monitor Receivers with the option R97 — Dual Call Common Tone A or option R177 — Dual Call Common Tone B, is completely different than the single tone version (long tone B or C type) discussed in the previous section. By choosing either tone A or tone B as common, two separate two-tone sequential calls are possible. One of these two is used as the group call address. Dual call group call has three advantages over the long tone B or long C method:

a) It requires less transmission time;
b) It can be used with any standard Motorola or competitive two-tone sequential encoder capable of sending Motorola tones an tone timing;
c) It provides formation of groups in excess of Long Tone B capability. This is greater than the group size provided by Long Tone B group call. Contact your System Engineering Group or Private Paging Marketing for more information.

For further discussion on the coding of Dual Call pagers, please turn to Appendix A, page 24.

IV.B. Motorola Two-Tone Sequential Subaudible Systems

Sub-Audible paging/alerting is not available with MINITOR II Alert Monitor Receivers.

IV.C. Motorola QUIK-CALL Signalling Systems

MINITOR II Alert Monitor Receivers are not available with four tone (two + two) QUIK-CALL signalling decoding capability. Hence, they cannot be directly interfaced into an existing QUIK-CALL signalling alerting system.

However, MINITOR II Alert Monitor Receiver active filters can be ordered on QUIK-CALL signalling type codes, and because of this, some measure of compatibility is possible.

A QUIK-CALL signalling code is composed of four tones: two tones transmitted simultaneously, a pause, and then a second pair of tones transmitted simultaneously. Figure 5 illustrates, graphically, the QUIK-CALL signalling code compared to a conventional two-tone sequential paging code. As you can see, the two coding formats are almost totally different.

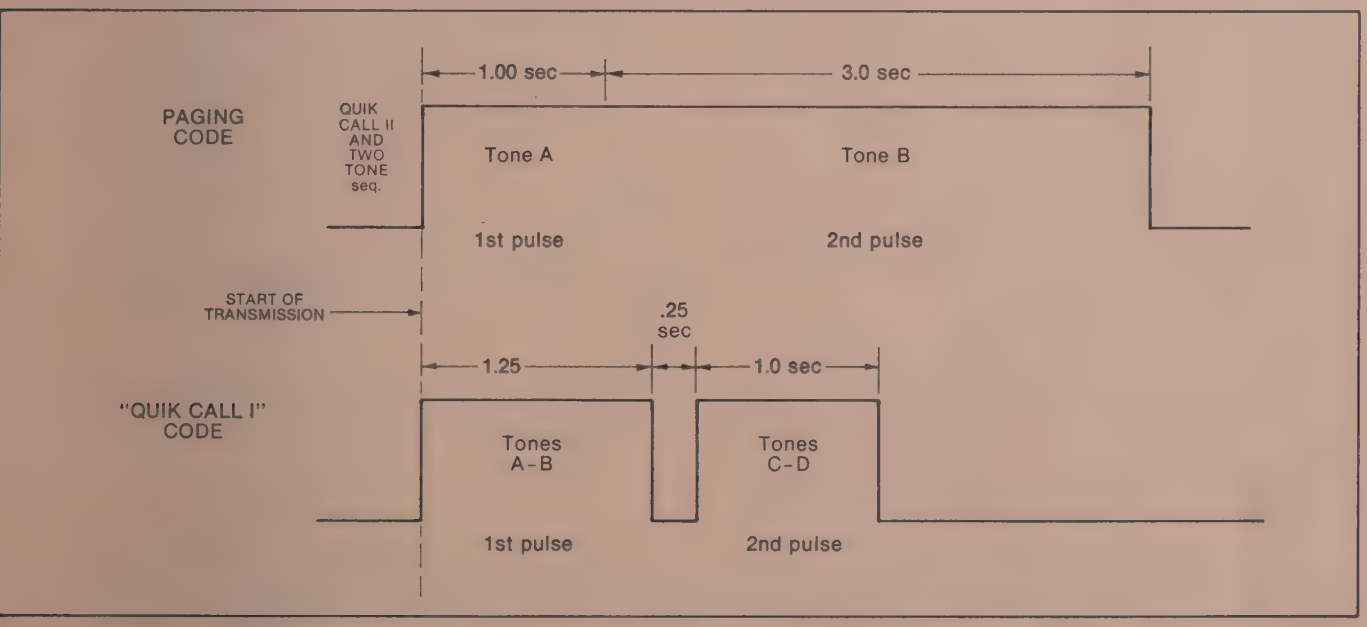


Fig. 5 "QUIK CALL" SIGNALLING COMPARED WITH A PAGING CODE

There is, however, one overriding similarity between the two systems, and that is that both systems use two bursts of tone codes transmitted via an RF carrier to contact a particular receiver/decoder. It is this basic similarity that *in some cases* can be capitalized upon for the measure of compatibility mentioned above.

A QUIK-CALL signalling encoder contains 12 Vibrasponder reeds and has a double row of 12 selector buttons. To send a QUIK-CALL signalling code, the operator pushes two of the upper row buttons (corresponding to the two tones in the first QUIK-CALL signalling pulse), two of the lower row buttons (corresponding to the two tones of the second pulse pair), and pushes a "Code Start" button. The code is automatically sequenced by a timer and sent to the transmitter just as in any pushbutton paging system.

To interface MINITOR II Alert Monitor Receivers into this system, the timing on the QUIK-CALL signalling encoder must first be modified to provide the longer 2nd tone required for two-tone paging. The modification is quite simple: A resistor and a two-position switch are added to the QUIK-CALL signalling console. One of the switch is labeled "Quik-Call", the other "Paging". When the switch is in the "Quik-Call" position, the timing is unchanged. Flipping the switch to the "Paging" position puts the added resistor in to the timing circuit and lengthens the 2nd code-pulse to three seconds. Then, the operator selects one tone from each row of buttons (instead of two) and pushes the "Code-Start" button to send what is now a paging/alerting code. This modification is fully described in a Service and Repair Note (SRN-197A). It applies only to systems using letter-coded tones in the 346.7 to 1161.4 Hz range, however.

To work with the above changes to the encoder, the MINITOR II Alert Monitor Receivers themselves require no modifications. They must, however, be equipped with the same QUIK-CALL signalling codes as those being transmitted by the encoder.

We mentioned that the modifications as called out in the SRN-197A were a possible solution to the MINITOR II Alert Monitor Receiver/QUIK-CALL signalling compatibility problem, *in some cases.* These cases, specifically, are those in which there are no other QUIK-CALL signalling receivers in the system, or on the frequency, with the same tones in the A,B positions. For example, a MINITOR II Alert Monitor Receiver in QUIK-CALL signalling system with an A/D code, will probably go off every time a QUIK-CALL signalling receiver with an AB/CD code, or an AF/DE or an FA/ED, etc. code is signalled. In fact, any QUICK-CALL signalling code with A as part of the first tone and D as part of the second tone will probably set off that MINITOR II Alert Monitor Receiver. Before implementing SRN 197A, check the QUIK-CALL signalling codes that are being used in your particular system and in any other QUIK-CALL signalling system within range on your frequency. Be certain that these are, in fact, non-interfering codes that can be assigned to the MINITOR II Alert Monitor Receiver. Contact your Area Systems Engineer for further details on combining alerting and QUIK-CALL signalling operations. Coordination of new tone assignments will be done by the Order Processing Department at the plant.

Note: It may be possible, under certain circumstances, to put MINITOR II Alert Monitor Receiver directly into a QUIK-CALL signalling system, without modifying the encoder as in SRN197A. If AB/CD, for example, is a valid QUIK-CALL signalling code in your system, it may be possible to code a MINITOR II Alert Monitor Receiver A/D and have it respond or "beep" when the AB/CD code is sent. If all system conditions are optimized, the MINITOR II Alert Monitor Receiver decoder should be able to "pick out" tone A from the AB combination and Tone D from the CD combination. Keep in mind, however, that as above, any QUIK-CALL signalling code within range with A as part of the first tone and D as part of the second tone, will also probably set off the radio. In addition, since the MINITOR II Alert Monitor Receiver will be receiving its tones on shorter, non-standard timing, performance is likely to be degraded. As a general rule, signalling a two-tone sequential MINITOR II Alert Monitor Receiver from an unmodified QUIK-CALL signalling encoder should be avoided wherever possible.

QUIK-CALL Group call

In the quick call signalling code plan, group call is accomplished by a 4-second burst of the second of the first two tones and the first of the last two tones. On a receiver coded AB/CD, group call would be accomplished by a 4-second burst of BC. Since the timing (4 seconds vs. 8 seconds) and the tone frequencies (two tones simultaneously vs. a single tone) used in the QUIK-CALL signalling method of group call are so different from the MINITOR II Alert Monitor Receiver type of group call, the two coding formats should be considered mutually incompatible.

IV.D. Motorola QUIK-CALL II Signalling Systems

QUIK-CALL II signalling and standard two-tone sequential paging/alerting systems have the same tone timing format. They are different only in that QUIK-CALL II signalling uses the QUIK-CALL signalling tone code frequencies. MINITOR II Alert Monitor Receiver equipped with the standard QUIK-CALL signalling tones wil interface perfectly into existing QUIK-CALL II signalling systems. However, QUIK-CALL signalling tones and standard paging/alerting tones should never be mixed in the same system. Such mixing can result in falsing problems.

IV.E Motorola and Competitive Singletone Systems

Since the selective call MINITOR II Alert Monitor Receiver is a two-tone sequential device, it is inherently incompatible with both Motorola and competitive singletone alerting systems. There are, however, two acceptable ways that MINITOR II Alert Monitor Receiver can be interfaced into existing singletone systems.

You will recall from preceding sections that the Long Tone B or C group call function in MINITOR II Alert Monitor Receiver is accomplished with a single tone — an 8-second burst of the tone B or C. Hence, MINITOR II Alert Monitor Receivers equipped with long tone B group call option, R138, or Long Tone C, R362, and coded with the proper singletone tone code in the tone B or C position can be sold into singletone systems provided two conditions are met. This can be done *only* when it has been determined that the encoder is generating its tones with the prescribed limits of ±0.5% from nominal frequency and *only* when the length of time that the encoder sends the tone is increased from the normal 3 seconds to 8 seconds. Both the proper tone stability and tone duration *must* be present to permit the group call equipped MINITOR II Alert Monitor Receivers to decode the singletone code properly.

A second way to interface selective call MINITOR II Alert Monitor Receivers into existing singletone systems is to replace the singletone encoder with a Motorola two-tone sequential encoder. If that can be accomplished, it is by far a more desirable approach.

As we mentioned earlier, both Motorola and competitive singletone systems work on a 3 second tone signal. That is, the encoder sends the tone coded signal for a duration of 3 seconds before the receivers decode it. Recall also, that all conventional Motorola two-tone sequential encoders send Tone B of the two tone code for the duration of 3 seconds. By installing a two-tone sequential encoder in place of the singletone encoder, and judiciously selecting the tones used in the two-tone encoder, it will, in many cases, reliably signal both the two-tone MINITOR II Alert Monitors and the existing singletone receivers in the system.

As an example, let's assume that we have an existing singletone alerting system that is currently using 2 individual call codes. One group of receivers alerts when tone A is sent, another group when tone B is sent. Let's fur-

ther assume that the prospect wants to add MINITOR II Alert Monitor Receivers to the group that responds to the tone B signal. By coding the MINITOR II Alert Monitor Receivers C/B and installing an alert central with 3 tones, A, B and C in it, the system would work as follows. To signal the A group of receivers, button 1 of the Alert Central encoder is depressed. This causes the Alert Central to send 1 second of tone C, which goes unnoticed by the older receivers in the system, and 3 seconds of tone A, which is decoded by the singletone "A" receivers in the system. To signal the "B" group, button 2 on the encoder is depressed. This causes it to send out 1 second of tone C and 3 seconds of tone B. The MINITOR II Alert Monitor Receivers "see" both of these tones and decode; the singletone receivers "see" only tone B and decode.

Many variations like this are possible. Contact your Area Systems Engineers when contemplating encoder changeouts.

NOTE: If it is unavoidably necessary to use the group call MINITOR II Alert Monitor Receiver approach of a singletone encoder, be sure that the tone stability of the encoder is within the ±0.5% guideline. Many singletone encoders including Motorola's are not capable of maintaining that level of stability reliably, and consequently, may not be able to signal the MINITOR II Alert Monitor Receivers.

IV.F. Motorola in Competitive Two-Tone Sequential Systems

When faced with the issue of placing selective call MINITOR II Alert Monitor Receivers in competitive two-tone sequential alerting systems, the best recommendation you can make is to persuade the customer to acquire a Motorola encoder of the proper capability for his system. This will assure the system quality required for optimum performance. In addition, in almost all cases, the customer can, at his own choice, continue to use his old receivers. The Motorola encoder will in no way degrade the performance of his existing system and may, in fact, significantly improve it. This section of the System Planner, however, will deal with those competitive situations in which an encoder trade-out is not possible.

When interfacing selective call MINITOR II Alert Monitor Receivers into competitive two-tone sequential alerting systems, the tone stability, tone frequency, and tone timing in use in the system must be evaluated very carefully. As mentioned in Part A of this section, selective call MINITOR II Alert Monitor Receivers:

a. operate only on tone frequencies in the range of 288.5 Hz to 3062.0 Hz.

b. require that the above tones be accurate to within ±0.5% of nominal frequency.

c. require conventional Motorola tone timing of one second/three second, with no intertone gap.

For optimum performance from the MINITOR II Alert Monitor Receivers, all three of these elements must be present.

Many competitors, however, have structured the two-tone sequential coding formats used in their systems to be substantially different from the previously described format used by Motorola. In most cases, the most *significant difference is in the area of tone timing*—many competitors use coding formats that are faster than ours, hence they are more apt to false, and less likely to decode in low signal areas.

1. Plectron Two-Tone Sequential Systems

Plectron offers two signalling formats for their two-tone sequential selective call receivers. Their standard coding format is a 3.0 second transmission of tone A, .25 second transmission of tone B. They also offer a fast timing option that requries a .75 second transmission of tone A and .25 second transmission of tone B. Figure 6 illustrates these two formats graphically.

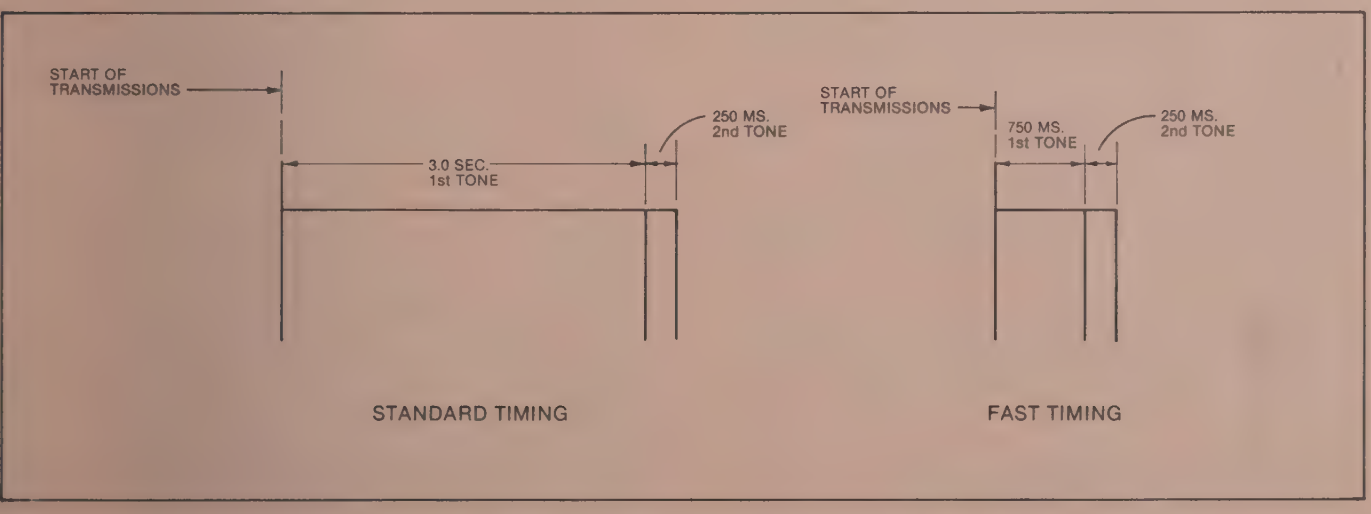


Fig. 6. Plectron Signalling Schemes

In order to interface MINITOR II Alert Monitor Receivers into an existing Plectron system using a two-tone sequential Plectron encoder, the following things must be done:

A. Check the encoder for tone stability. MINITOR II Alert Monitor Receivers require ±0.5% stability which should be within spec for most two-tone Plectron encoders. If the tone frequencies on your customer's encoder requires adjustment, the instruction manual that Plectron ships with each encoder clearly explains how this is done.

B. The *encoder should be modified* so that the duration of the tone B tone is lengthened from 250 ms. to a *minimum* of 750 ms. For optimum performance, the Tone B timing

should be 3 seconds. Again, the Plectron encoder manual provides information on how this is done. The key point here is that the MINITOR II Alert Monitor Receiver decoder should "see" a minimum of 750 ms. of tone B in order to decode reliably although 250 ms. will suffice. No internal alert tone will be provided with 250 ms. timing on the second tone and an alert tone must be sent over the air. Remember, this is a minimum number. The closer tone B can be adjusted to 3 full seconds, the better the MINITOR II Alert Monitor Receiver will perform. In fact, even the Plectron receivers may benefit by transmitting the longer tones.

NOTE: When placing MINITOR II Alert Monitor Receiver in "standard" coding Plectron systems that use the 3 second tone A, it is not necessary to shorten that tone to one second. The two "extra" seconds have no adverse effect on the MINITOR II Alert Monitor Receivers, but adjusting them out may impair the performance of the Plectron receivers. As always though, tone B should be lengthened to the 750 ms., minimum. If it is not, the MINITOR II LED will not operate when a call is received.

Group Call

The optional group call feature that Plectron offers for their two-tone sequential alerting system is provided by using a third tone. By using a common tone A, Plectron is able to get two separate two-tone "calls" out of each receiver. One two-tone call is used as the individual call code, the other as the group call code. As an example, let's take a Plectron group call receiver with the three tones, A, B and C. By using the common tone A approach, we can see that the receiver is capable of decoding both an A/B signal and an A/C signal, either one of which could be the group or individual call depending upon how tones are assigned. This configuration is provided in MINITOR II Alert Monitor Receivers with the R97, Dual Call Common Tone A, Option.

Since Plectron group call is based on a two-tone sequential format, you can see that it is completely incompatible with the MINITOR II Alert Monitor Receiver Long Tone B or Long Tone C (single tone) group call coding scheme. In situations where interface into Plectron group call systems is required, you must use the MINITOR II Alert Monitor Receiver with A-B, A-C calls. These models function on the same three tone, common tone A signalling format used by Plectron. For further details on MINITOR II Alert Monitor Receiver group call signalling, refer to page 24, Appendix A of this System Planner.

NOTE: When interfacing MINITOR II Alert Monitor Receiver models with the Dual Call option into Plectron group call systems, encoder tone stability and tone timing must meet the same minimum standards that pertain to Plectron non-group call systems. Refer to page 13 for a detailed discussion of these requirements.

As a general rule, when interfacing MINITOR II Alert Monitor Receiver into any Plectron system, it is a good idea to contact Area Systems Engineering for assistance. The plant should also be contacted if the situation warrants.

2. G.E. Two-Tone Sequential Systems

Motorola vs. GE Active Filters

Motorola active filters are based on a "constant Q" filter configuration. This means the the filter bandwitdth varies with the frequency of the filter. The bandwidth of a Motorola filter is approximately 0.5% of the filter center frequency. Thus, at 288.5 Hz (the lowest possible tone), the bandwidth is 1.44 Hz, while at 2468.2 Hz (the highest Group 11 tone), the bandwidth is 12.34 Hz.

GE active filters are based on a "constant bandwidth" filter configuration. This means that the filter bandwidth does not change as a function of the filter frequency, but is the same for all filter frequencies within the GE tones.

Motorola vs. GE Code Plans

Because the Motorola active filters are "constant Q", the Motorola code plan is set up to utilize tone frequencies which are separated from each other by a fixed percentage difference. For the standard audible Groups 1 through 6 and Groups 10 and 11 tones, this is approximately 2.8% of the adjacent tone frequency; i.e., 349.0 Hz (tone 111) is 2.8% higher in frequency than 339.6 Hz (tone 141).

The GE code plan, because their active filters are constant bandwidth, is set up with a fixed frequency spacing between all tones. This spacing is 15 Hz.

Motorola vs. GE Compatibility Problem

Code selection and compatibility of Motorola pagers in GE systems is determined by the 15 Hz intertone spacing of the GE code set. This affects compatibility in two ways.

1. Any Motorola tone closer than 15 Hz of a GE tone could possibly false a GE tone.

2. Any Motorola active filter higher than 682.5 Hz (15 Hz/2.8%) could possibly be falsed by a GE tone.

Code Selection for Compatible Systems

Based on the previous discussion, the following criteria applies to selected codes compatible in a GE system.

A. **Motorola Pagers on GE Codes**

1. Limit highest active filter frequency to 682.5 Hz. This eliminates 18 of 30 GE tones available and reduces the number of usable calls from 900 to 132 which can be safely substituted with Motorola pagers.*

2. Limit the GE code plan to those codes whch have 30 Hz frequency separations. This would reduce the number of usable calls from 900 to 450, but would allow direct substitution of a Motorola pager for any address remaining.

*The actual number of calls realizable is 144, however, since the "diagonal" tone or repeat tone is 742.5 Hz, calls requiring the use of the diagonal tone must be excluded.

B. **Motorola Pagers on Motorola Codes**

Limit the Motorola code plan to those tones greater than 15 Hz of a GE tone. The number of usable tones are 21 below 502.5 Hz and 13 above 997.5 Hz (due to frequency, upper limit requires 30 Hz separation). Via the "general encoding method", 184 calls are available. Via the "code assignment method", 552 calls are available, excluding groups 10 and 11.

3. Other Two-Tone Sequential Competitive Systems

In addition to Plectron and G.E., there are many competitors marketing two-tone sequential alerting systems. Each one of these competitors has a unique "twist" to their signalling formats that makes compatibility tricky. When attempting to sell MINITOR II Alert Monitor Receivers into such systems, be aware of the major issues of tone frequency, tone stability, and tone timing.

Almost every competitive encoder, as long as it is stable within ±0.5% can be modified to send Motorola timing. In many cases, how to do this is spelled out in their own manual. **The modification usually consists of a simple resistor or capacitor value change.**

Before ordering MINITOR II Alert Monitor Receivers for use in any competitive system, be sure to check with Area Systems Engineering. The issue of code compatibility is a complex one that requires careful evaluation prior to the sale.

V. "MINITOR II" ALERT MONITOR RECEIVER SYSTEMS

Local terrain, atmospheric conditions, building density, transmitter power, antenna height, and the sensitivity spec, among other things, greatly influence MINITOR II Alert Monitor Receivers range of coverage. As a general rule of thumb, however, when planning a MINITOR II Alert Monitor Receiver system, it may be said that MINITOR II Alert Monitor Receiver will reliably receive **over half the distance of any mobile radio in that this includes street coverage only. In-building coverage depends upon the building construction.** For example, if you are currently operating a system and your mobiles can receive your base station 20 miles away, generally it may be said that MINITOR II Alert Monitor Receivers will provide receive coverage up to 10 miles from the base station. **Remember, this is only a general rule of thumb, not a hard and fast rule.** In any situation where system coverage is an issue, Area Systems Engineering should be involved.

V. A. Alerting added to an Existing Two-Way System:

In the case of a Radio Alerting System, often the customer will want to combine his alerting system with two-way radio or add it to an exisitng two-way system. Combining carrier-squelch mobile and/or non-selective portable units with radio alerting receivers, requires only the addition of an encoder resulting in the basic system diagrammed in Figure 2 on page 2. Because the mobile units have no tone decoder however, they will receive all messages on the channel, including the selective call code tones generated by the encoder. In a large system this can be very annoying to mobile users.

In a mixed system that uses Private-Line tone-coded squelch, the situation becomes a bit more complex.* Naturally, the user wants to transmit the PL tone when he talks to his mobile or portable units. But the PL tone must be eliminated during transmissions of alerting messages for two reasons. First, the absence of PL tone will normally keep the mobiles from receiving any part of the alerting tones or message. Second, PL tones can mix with the alerting code tones causing "falsing" — the generation of false codes which could activate the wrong alert monitor receivers. Therefore, when alerting is used in a PL two-way system, in most cases a conversion kit is added to the base station which disables the transmiter PL tone during alerting messages, but allows the PL tone to be sent during transmissions to the mobile units.

* PRIVATE-LINE (PL) is Motorola's trade name for its tone-coded squelch method. In a tone-coded squelch system, all transmitted messages contain a continuous sub-audible tone. This PL tone will hold open the audio circuit of all the receivers that are equipped to respond to that particular tone. Tone-coded squelch radios have provision for disabling the receiver PL squelch circuit in order to monitor the channel, during which time they receive all messages on the channel. PL tones are sub-audible, having frequencies below 202 Hz.

V. B. MINITOR II Alert Monitor Receiver Sensitivity vs. Mobile or Table-Model Monitor Receivers:

This section will help you answer a basic question on MINITOR II Alert Monitor Receiver sensitivity which many customers will ask. Sensitivity is important in that it is fundamental, once the transmitted signal and terrain are defined, to system coverage or range. Sensitivity is defined as the ability of the receiver to pick up a weak signal and amplify it so that it can be understood by the listener. The more sensitive a radio receiver, the weaker the signal it can receive. And normally, the more sensitive a receiver, the greater its area of reception. Alert sensitivity is the most common sensitivity spec used to measure the intensity of the incoming signal required to trigger the MINITOR II Alert Monitor Receiver's decoder. The lower the number of microvolts or microvolts per meter, the better the receiver sensitivity.

Receiver sensitivity is specified in two ways.

1. The *chassis sensitivity* of the receiver, often called 50 *ohm sensitivity* is basically the measurement of receiver sensitivity witnout the use of the antenna. Signal is injected directly into the radio. Its ability to pick up this signal, without using the antenna, is measured. This 50 ohm sensitivity is measured in microvolts (μV) usually less than .5 μV.

2. The *radiated sensitivity* differs from the chassis sensitivity in that it measures the effectiveness of the receiver to pick up a transmitted signal using the receiver's antenna. Often called *field strength* sensitivity, this is a measurement of the receivers' sensitivity as well as the effectiveness of its antenna. Field Strength sensitivity is measured in microvolts per meter (μV/m) according to the EIA standard for 8 position average. This number is typically 4μV/m or greater.

To help explain the relationship between the two measurements let's look at an example. Let's take a receiver with a 50 ohm alerting sensitivity of .15 microvolts. This receivers' chassis sensitivity is perfectly respectable, however, let's assume that this receiver has a poor antenna. The result is a relatively poor radiated sensitivity measurement of 25 microvolts per meter. That very same receiver with a very good antenna and ground plane may have a Field Strength sensitivity of 1 or 2 microvolts per meter. (Remember the lower the number of microvolts or microvolts per meter, the more sensitive the radio receiver.)

MINITOR II Alert Monitor Receivers have chassis (50 ohm) sensitivities as good as or better than most mobile or table-model monitors on the market today. However, do not let this mislead you or your customer. Because the MINITOR II Alert Monitor Receivers have small internal antennas similar to those found in pagers, the MINITOR II Alert Monitor Receivers *will not generally* have as much range as the table model receivers. This is because of the more efficient larger external whip or vehicular antennas used by monitors.

The MINITOR II Alert Monitor Receivers worn on the body will have operating ranges comparable to a pager operating in the same frequency band. This sensitivity will, with few exceptions, be adequate for a customer to receive his messages throughout the desired coverage area. If there is reason for doubt, perform an actual coverage test to prove whether or not the MINITOR II Alert Monitor Receiver will provide coverage over the area of interest to

the customer. Area Systems Engineering can be of great help in defining coverage areas and expected performance within these areas.

Remember also that the MINITOR II Alert Monitor Receiver in its charger or charger/amplifier with the external whip (or wire dribble, for low-band VHF) antenna has an improved radiated sensitivity over the MINITOR II Alert Monitor receiver when worn on the body. This makes it as good as or better than any existing table model alert monitor with its external antenna. Use of a vehicular antenna with the MINITOR II Alert Monitor Receiver will also enhance performance even more. This ability to operate with an external antenna provides an answer for customers who sometimes need more sensitivity than the MINITOR II Alert Monitor Receiver can offer. When in a building with extensive shielding properties or in a remote fringe area, the charger antenna or vehicular antenna can often provide solid coverage capability.

V. C. MINITOR II Alert Monitor Receivers in Systems with Repeaters:

In a repeater system a transmission originated by a mobile or base station is picked up by the repeater station and rebroadcast. The idea is that a repeater system produces much greater effective range and consequently the repeater is often located on top of a mountain or some other site that offers the prospect of maximum coverage. Frequently these sites are relatively inaccessible.

Generally, the mobiles and base stations that are members of a "Repeater" system transit a "Private-Line" tone in order to gain "access" to the repeater — otherwise, the repeater would rebroadcast all messages it picked up. By the same token, the repeater usually retransmits messages along with a PL tone to prevent nonsystem receivers from hearing the rebroadcast. In a PL repeater system, there is usually no way to disable the transmit PL tone unless there is a wireline control to the repeater station.

This causes some problems when an alerting receiver is to be used in a PL Repeater System unless special measures are taken to avoid them. First, the mobiles have to listen to the alerting code-tones and messages. Secondly, there is a possibility of falsing due to intermodulation if the PL tone levels are not carefully adjusted, and the alerting tones chosen with great care.

One other limitation is that the lower frequency code tones will not pass through the repeater with sufficient deviation, so that only the higher frequency tones (tone groups 2, 5 and 6 or a limited number of QUIK-CALL signalling lettered codes) can be used. This will limit the maximum call capacity in a system

Many customers can operate within the limitations we have described; but if not, contact Area Systems Engineering. They may be able to apply one of the following solutions:

1. Wire access to the repeater, removing all the previously listed limitations.

2. Modify the base station and repeater to provide "Single Tone" access to the repeater during alerting transmissions, causing retransmission without PL tone.

3. Modify base station and repeater to provide a unique PL tone for access during alerting transmissions, causing retransmissions without PL tone.

4. Use one-channel of a community repeater with a unique PL tone to cause retransmission without PL tone. Access to the repeater would be via one alerting /PL tone for all alerting receiver users on the community repeater.

These solutions can be applied by Area Systems Engineering by specially adapting presently available PL/paging kits.

V. D. MINITOR II Alert Monitor Receivers in Trunked Systems

There are products that can provide integration of VHF and UHF communications systems with Smartnet mobile and portable systems. THe PAC*TL system is a VHF or UHF vehicular repeating system that interfaces with and extends the capabilities of Motorola Smartnet trunked mobiles. Using the PAC*TL systems, VHF or UHF mobiles and portables can talk on the trunked system to trunked mobiles and portables, and vice versa. PAC*TL can also provide communications from trunked mobiles or portables to systems using VHF or UHF MINITOR II Alert Monitor Receivers.

Users that upgrade from VHF or UHF to Smartnet trunking should retain two of their old channels. One VHF or UHF channel is used for wide area alerting on frequency one of the MINITOR II Alert Monitor Receiver. Audio from the dispatcher can be simultaneously transmitted from a Centracom Series II trunked console on the VHF or UHF alert channel base station and on the trunked system's designated alert subfleet. In this way, equipment and personnel can be dispatched to the scene via MINITOR II Alert Monitor Receivers or trunked radios.

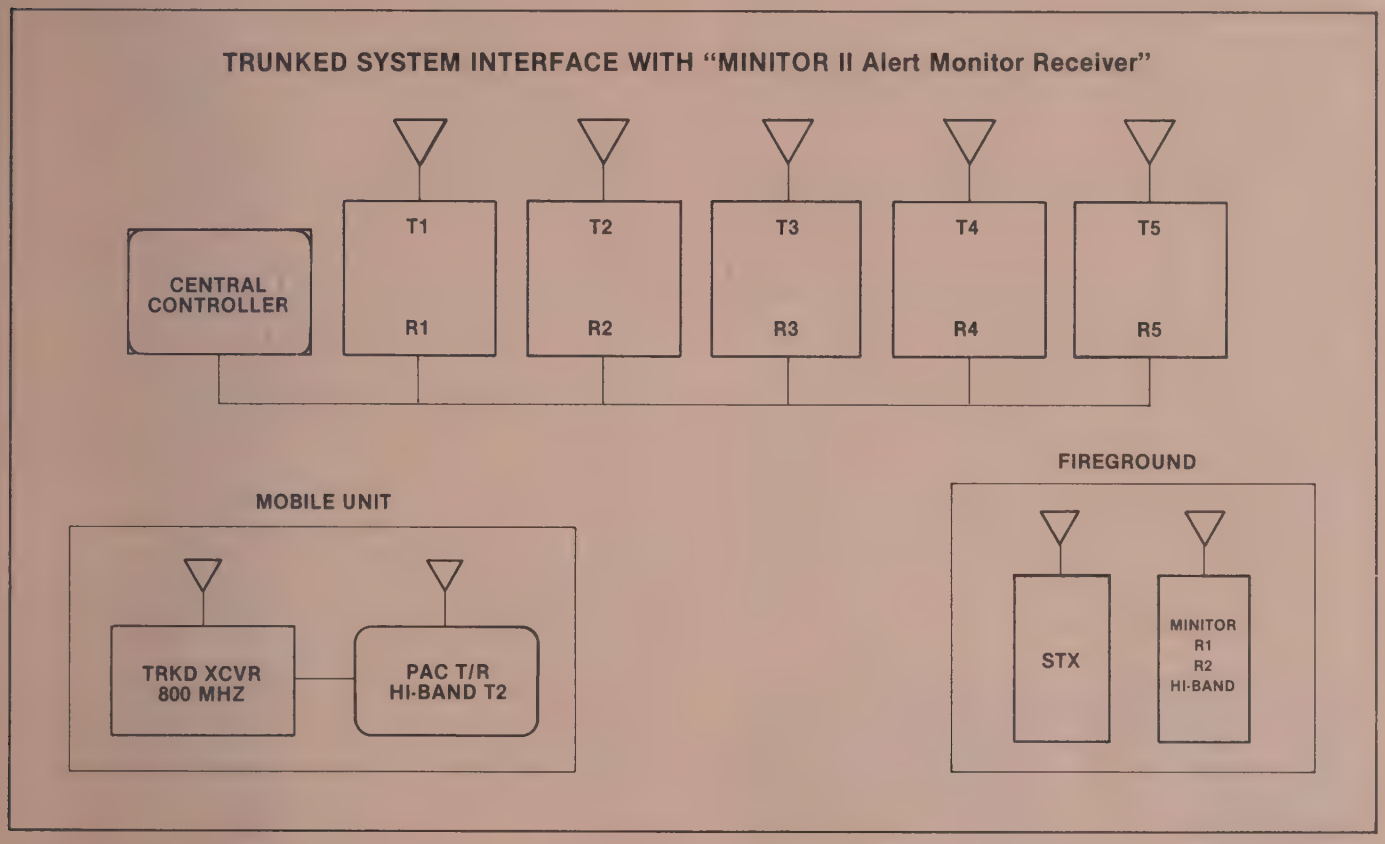
At the scene, the other VHF or UHF channel is used for fire ground control. The MINITOR II Alert Monitor Receivers are switched to frequency two to free the alert channel for other incidents. With a vehicle equipped with a Smartnet trunked mobile and PAC*TL repeater on site, supervisors with trunked radios can direct operations to the MINITOR II Alert Monitor users. The subfleets switch to one of the fire ground control subfleets. The portable's audio is routed through the trunked system to the PAC*TL equipped mobile, which retransmits the audio of the VHF or UHF fire ground control frequency. Since the PAC*TL transmitter is low power, the fireground control VHF or UHF transmissions will be localized to the incident scene. If a subsequent incident should occur, the fireground control channel could be reused by another fireground subfleet at at different location with minimal interference.

If more than one PAC vehicular repeater is at a site, the operators should disable all but one unit. All communications can then be repeated through one mobile unit. Thus eliminating interference caused by the simultaneous activation of several mobiles. If more than one PAC repeater will frequently be at a site, PAC*TR systems are recommended. PAC*TR repeaters contain logic circuitry that handles multiple PAC repeaters at the same location, on the same frequency. They automatically prioritize only one repeater and mobile radio through which all communications are routed.

Low Band PAC*TL's and PAC & TR's are not available. Users upgrading to Smartnet from Low Band systems should obtain two VHF or UHF channels for wide area alert and fire ground control operation with two frequency MINITOR II Alert Monitor Receivers. If this is not possible

or feasible, two Low Band channels should be retained. Some Low Band mobiles should also be retained for supervisors to use for fire ground operation, one per incident site.

Due to the low power (200mw) of the PAC*TR, coverage may not be adequate for large buildings, industrial complexes etc. This is not recommended if such environments are common.



VI. SYSTEM COMPOSITION

To function, every selective tone-and-voice alerting system must have an encoder, base station, antenna, microphone, and one or more receivers.

1. Base Station

Any standard Motorola two-way base station can be used in a manual paging system. In an add-to situation, the customer will already have a base station; in a new system you'll have to advise him of the type to order. Selection should, of course, be made on the basis of his desired range, location, type of control, and so on. Consult your two-way literature or Systems Engineer if you need guidance on these points. In PL installations, PL Conversion Kits (see Appendix A, page 22.) must be added to some existing base stations. This allows removal of PL tones during transmission precluding any possibility of improper alerting due to the mixing of the paging tones with the PL. It also allows paging to take place without disturbing any other two-way PL radio users with the paging tones and messages.

2. Antenna

The standard lineup of two-way antennas can be used in VHF and UHF paging systems. The best antenna for a specific installation will be determined by the system requirements.

3. Microphone

A microphone must, of course, be used to provide voice capability in tone-and-voice systems. The specific microphone used, depends on the type of encoder in the system and on the type of squelch the system uses (see Appendix A).

4. Manual Encoders

The low capacity series encoders are designed to function in only local control applications either working with a local base station or working in conjunction with a nearby remote control console. This means the base station or remote console is less than 50′ away from the encoder.

The E08PLS2000, MODEN Plus and the E08PFD/PFE, People Finder can be used in either a local mode or in a tone binary remote mode. Up to 2,000 calls are possible (500 with the People Finder).

VI. A. LOCAL CONTROL

1. E08ENC0036L, E08ENC0100L and Alert Central

These models are connected to the base station with a TKN6065 cable kit in most cases. This is a 5-wire, spade lug cable which directly connects to the encoder and base. To complete a standard squelch system, add a TMN1004 microphone, which includes a 9 ft. connector cable that connects to the encoder.

For PL systems, use a TMN1005 microphone, which has a split-bar switch. Pushing one-half of the bar disables the receiver PL squelch so that the operator can monitor the channel prior to transmission. Pushing the other half actuates the transmitter. In a local control system the encoder "T" (Transmit) button actuates the PL Conversion Kit in the base station. When the PL Conversion Kit is activated by the encoder, the transmit "PL" tone is disabled (stripped). Thus, the paging tones and voice messages sent to pagers without "PL" tone are not heard by mobiles in the system.

Pressing the microphone "Xmit" bar causes normal PL transmission to mobiles or portables (see appendix for PL Conversion Kits).

If either the MODEN 100 or 36 is used with a Paging Central MAXAR Base Station, the microphone and cable are furnished with the base station and need not be ordered separately.

2. E08PLS2000T, MODEN PLUS and E08PFD/PFE, PEOPLE FINDER

The MODEN Plus (Figure 7a) and the PEOPLE FINDER (Figure 7b) provides either tone or tone/binary (P.U.R.C.) base station control. They do NOT accommodate DC control. If D.C. control is required, the encoders must be used in the local mode in conjunction with a D.C. control remote control console. In some cases, it may be possible to apply a D.C. to tone control conversion kit at the base station. Consult Base Station Marketing for the specific station capabilities.

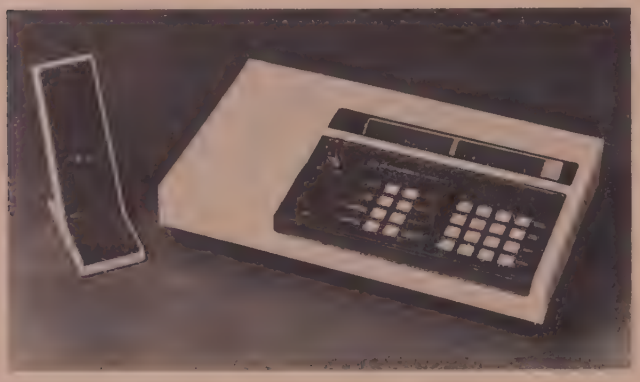


Figure 7a
a. "MODEN" PLUS

For PL systems using MODEN Plus, use a TMN 1005 microphone. In PL system transmit, PL disable (stripping) is accomplished only by the encoder transmission while use of the microphone paddle permits PL transmission to mobiles or portables.

Figure 7b
b. PEOPLE FINDER

For PL systems using People Finder, the People Finder strips PL on paging. Use the "F3" key and the internal microphone to transmit PL to mobiles or portables.

ENCODERS:

1. N1019 and L08 Series Encoders

Obsolete Motorola encoders such as the N1019 and the L08 ENC series will not be discussed in this system planner.

2. MODEN Series Encoders (E08ENC Series)

E08ENC (MODEN) series encoders are capable of local operation, with carrier or PL squelch. Code capacity is six to 100 calls (see code tables for code plan format).

As in all the MODEN Encoders, tone frequencies are generated by a solid-state synthesizer containing frequency ROM's.

a. "MODEN" Alert Central

Figure 8, is a six tone **non-expandable** manual encoder. Featuring single button operation, this model is **designed especially for use in fire and rescue alerting systems.** It has the capability of signalling up to five individual pagers or five individual groups (each pager in the group having the same pager code) including all the pagers in the system via the all call feature. By depressing a single button, every pager in the system can be alerted simultaneously. **The Long Tone C group Call is not possible with this encoder.**

Figure 8
"MODEN" ALERT CENTRAL

b. "MODEN 100" ENCODER

Figure 10, is a 100 call, **non-expandable** manual encoder. It has the capability of 90 individual codes and ten groups, with nine pagers per group for Long Tone B Group Call. For Long Tone C Group Call, see Tables 7 and 8 on pages 26 and 27.

Figure 10
"MODEN 100" ENCODER

All of the above models are designed for local control, or remote control using a remote console. This will be discussed in the system design section.

d. PEOPLE FINDER

The People Finder, Figure 7b, is a 500 call, non-expandable manual or telephone interconnect encoder. It has the capability of 399 individual two tone codes and 10 groups, with nine pagers per group for Long Tone B Group Call.

For pagers that do not have "Pager Group Call", the basic People Finder system can be programmed by the customer to sequentially page up to 75 members in one group. If additional groups are required, an "Expanded Group Call" Option (R421) allows up to 9 groups with total sum of all members in all groups equalling 75.

e. SERIES 90 DESK SET

The Series 90 Desk Set is available with an optional encoder that has the same capabilities as the MODEN 100 Encoder. It is capable of Local, Tone, or DC Control.

f. CENTRACOM SERIES II PAGING ENCODER

"The CENTRACOM Series II Paging Encoders with the K347 Paging Options provide the 254 most commonly used Motorola, Bramco, G.E., Plectron, Bell & Howell, Comex, and Federal tones between 288.5 and 3062.0 Hz with various timing formats. A few Reach tones are included. It should be noted, however, that not all of these codes could be used on any one channel because of potential falsing of different manufacturer's pagers due to the close proximity of many of the tones used by the different manufacturers. An extended version of the "Metro-Page" Terminal coding scheme is used. The different timing options of the K347 are indicated by suffix: (multiple K347's may be ordered)

K347AB Tone and Voice, 1 sec. Tone A & 3 sec. Tone B; 8 sec. group call*
K347AC Tone Only, .4 sec. & .8 sec.; 8 sec. group call*
K347AD Battery Saver, 2.7 sec. & .8 sec.; 8 sec. group call*
K347AE Competitive, 2.7 sec. & .8 sec. plus 2 sec. alerting Warble Tone; 3.5 sec. group call*, followed by 2 second Warble Tone

"Once the Paging switch is pressed, the clock display prompts the operator to enter the four digit paging code via the 16 digit hex-keypad on the Master Control Panel. The entered code is transmitted on the selected channel when the Signal switch is pressed. Pages may be entered and stored (along with channel information) through the use of "Pre-programmed" buttons.

*group call accomplished using one tone for 8 seconds

"The Control Centers" Product Group has a convenient dial-up computer program for figuring out which buttons to push to alert the customer's units. Area Systems Engineering has access to this program, as can anyone with access to a CMS account. Copies of the Applesoft Basic or IBM BASIC program are available upon request (312) 576-6012 for any customer who would like to type it in to his personal computer."

VI. B. REMOTE CONTROL

In a remote control radio system, the base station is separated from the controls, often by a considerable distance. The remote control unit must provide all the necessary transmitter controls, and because of the distance between the controls and base station (which attenuates the audio signals), the remote control unit may also contain an audio compression amplifier. Thus, the encoder in a remote control alerting system must either supply remote control capability, or a remote control console (T1200, T1300 or T1600 series) must be used with the system.

1. Local Encoders with Remote Control Consoles

The local MODEN and Alert Central Encoders do not provide remote control capability (including receive audio). To provide these functions, they must be directly connected to a remote control console, either DC or ton control (see appendix for appropriate model). The correct microphone for the given system requirement must also be ordered separately.

In a remote control PL system, a PL Control Kit must be installed at the control console end of the system. This activates the transmit PL disable circuits provided at the base station by the PL conversion kit. In a DC remote control PL paging system, a separate direct line between the encoder and the PL Conversion Kit on the base station is impractical, so another method of sensing the origin of the transmission is used. The encoder transmitter keying circuit is connected to a PL Control Kit in the ensole which, when encoder tones are to be transmitted, sends a negative voltage control signal to the base station. Pressing the transmit bar on the microphone sends a positive control signal. The PL Conversion Kit at the base station uses the difference in polarity to distinguish the origin of the transmission, and disables the transmit PL during paging voice message transmissions.

In tone control systems, the PL control kit in the console which, when encoder tones are to be transmitted, sends a function tone of 1850 Hz prior to the paging tones, eliminating PL tone. Pressing the "Xmit" bar on the microphone sends a 1950 Hz function tone prior to sending voice for mobile to portable operation with PL. The PL conversion kit at the base uses the difference in these function tones to distinguish the origin of the transmission.

2. E08PLS2000T, MODEN PLUS and E08PFD/PFE, PEOPLE FINDER

These encoders provide transmitter control function and

monitoring capability, and remote control consoles are not NORMALLY required. There may be applications, however, where the feature of the remote console are needed. For example, if D.C. control is required, use the MODEN Plus or the PEOPLE FINDER in local mode with a DC remote T1600.

When options such as clock, handset, frequency switch, etc., are required, again, the Moden Plus Encoder may be used with a remote console.

In multiple remote control applications, a complete encoder is required at each location where paging is to be originated.

These remote encoders in this multiple dispatch application are tied to the supervisory encoder by a two or four wire line. Due to line loss and insertion loss of encoders, only a maximum of six encoders can be interconnected. The telephone company will rent the wire lines which tie the encoder to the remote control base station.

3. Multiple Dispatch Points

In all multiple remote applications using any of the E08 series encoders, the system must have a control point (either remote console, MODEN Plus or PEOPLE FINDER Encoder) with the appropriate line operated transmit light (LOTL) at the dispatch points if visual monitoring is required at those points (see Figure 12).

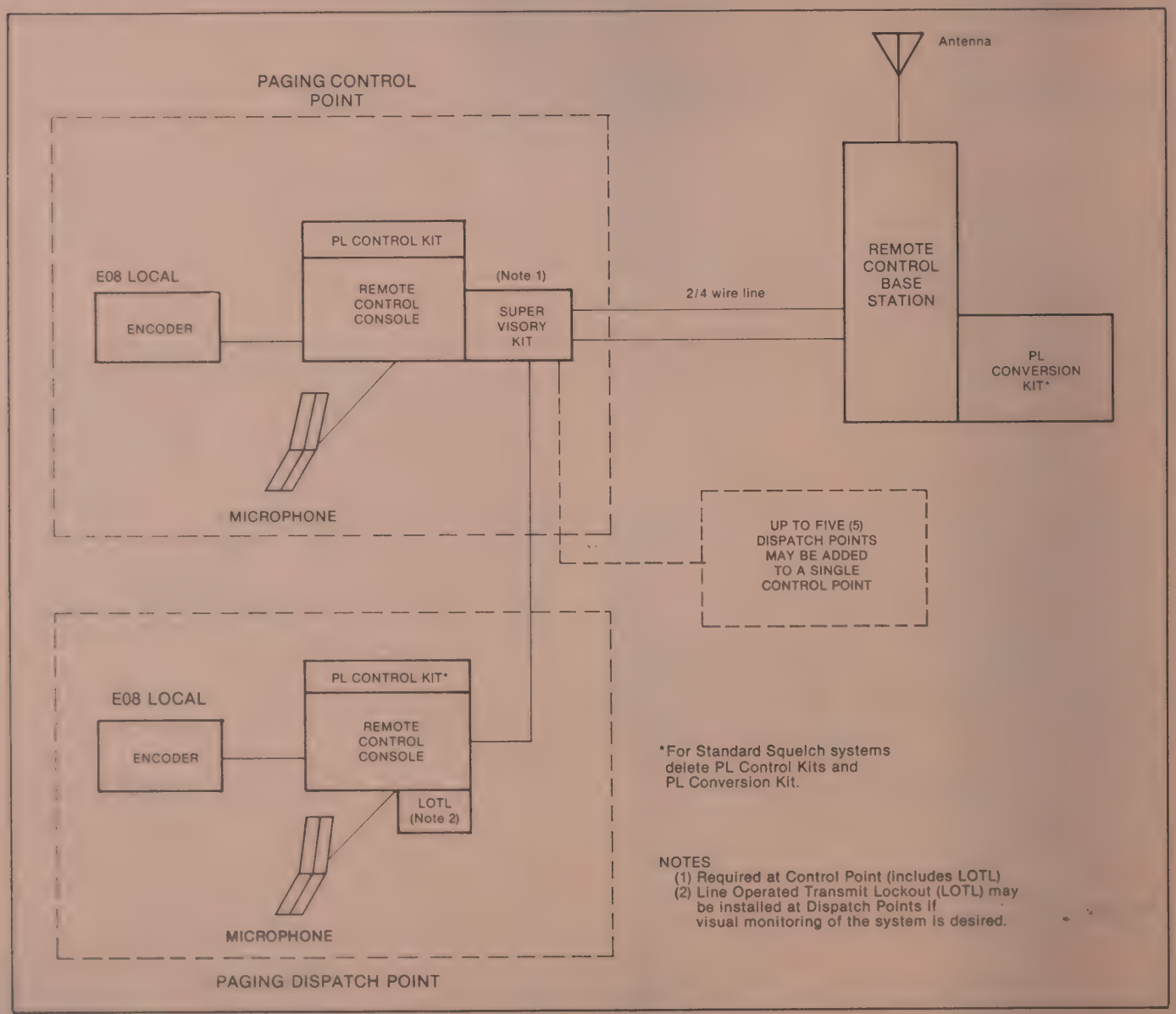

Antenna
PAGING CONTROL POINT
PL CONTROL KIT
E08 LOCAL
ENCODER
REMOTE CONTROL CONSOLE
(Note 1)
SUPER VISORY KIT
2/4 wire line
REMOTE CONTROL BASE STATION
PL CONVERSION KIT*
MICROPHONE
UP TO FIVE (5) DISPATCH POINTS MAY BE ADDED TO A SINGLE CONTROL POINT
PL CONTROL KIT*
E08 LOCAL
ENCODER
REMOTE CONTROL CONSOLE
LOTL (Note 2)
MICROPHONE
PAGING DISPATCH POINT
*For Standard Squelch systems delete PL Control Kits and PL Conversion Kit.
NOTES
(1) Required at Control Point (includes LOTL)
(2) Line Operated Transmit Lockout (LOTL) may be installed at Dispatch Points if visual monitoring of the system is desired.

Fig. 12. REMOTE CONTROL PUSHBUTTON SYSTEM WITH A PAGING DISPATCH POINT

GENERAL ENCODING METHOD

Each selective call MINITOR II Alert Monitor Receiver in the system is assigned a three digit cap code — SIMPLY CALLED **"CAP".** The relationship between the "cap" and the call to which a receiver will respond to is established by the general encoding method.

The 80 available alerting tone frequencies are divided into eight groups of ten tones each. These groups are numbered and designated tone groups 1-6 and 10-11, etc. Table 3 shows the tone codes and frequencies.

The first digit of the three-digit "cap" (for a particular call) determines the groups from which tones A and B will be selected, as indicated in Table 1. The next two digits of the "cap" identify tones A and B respectively, as selected from the tone groups indicated in Table 1.

To determine the tone frequencies or tone codes for a specific MINITOR II Alert Monitor Receiver call, proceed as follows:

(1) Locate the first digit of the "cap" in the first column of Table 1.

(2) In columns 2 and 3 of Table 1, find the tone group numbers for tones A and B that correspond to the first digit of the "cap".

(3) Locate the second digit of the "cap" in the first column of table 3. This is the tone number for tone A.

(4) Locate the tone group number for tone A in Table 3 (determined in step [2]). The tone code and frequency are indicated for tone A under the tone group.

(5) Locate the third digit of the "cap" in the first column of Table 3. This is the tone code for tone B.

(6) Locate the tone group number for tone B in Table 3 (determined in step [2]). The tone code and frequency are indicated for tone B under the tone group.

EXAMPLE: "Cap," 635 — According to Table 1, the first digit of this "cap" [6] indicates that tone A is selected from tone group 2, and tone B is selected from tone group 1. The second digit of the "cap" [3] indicates that tone 3 of group 2 is used for tone A, and the third digit shows tone 5 of group 1 is used for tone B. This unit has the following active filters installed:

"Cap," 635-
Tone A = Tone Code 123, Frequency 669.0 Hz
Tone B = Tone Code 115, Frequency 433.7 Hz

High Capacity Encoding Method

This encoding method was devised to accommodate the large number of pagers used in high capacity paging systems. Receiver "caps" encoded by this method are assigned a letter prefix. This prefix is the "Code Type" designation. In the general encoding method, the relationship between the first digit of the "cap" and the groups slected is arbitrary. In the code assignment method, the selected groups depend on the system code type. Table 4 shows the group selection scheme by code type. In essence, each code type column in this table is used in the same way as Table 1 was used in the general encoding method. In the column for the pager prefix, on the line corresponding to the first digit of the "cap", will be located the groups from which tones A and B will be selected. Table 4 and the second and third digits of the pager code determine the exact tone codes from Table 3 as outlined in steps 3-6.

EXAMPLE: "Cap," D476 would have the following tones installed:

Tone A = Tone Code 117, Frequency 483.5 Hz
Tone B = Tone Code 156, Frequncy 767.4 Hz

D4	**7**	**6**
FROM TABLE 4 (CODE TYPE D: FIRST DIGIT 4)	TONE A FROM TABLE 3 (TONE 7: GROUP 1)	TONE B FROM TABLE 3 (TONE 6: GROUP 5)
TONE A IN GROUP 1	CODE = 117	CODE = 156
TONE B IN GROUP 5	FREQUENCY + 483.5 Hz	FREQUENCY = 767.4 Hz

GROUP CALL ENCODING METHOD

a. Long Tone B or C Type

Alerting Receivers with more than one call are assigned "caps" for each of the calls. If a group call "cap" is used, all of the Receivers in the same group will be alerted. The group call "cap" is assigned in the same way as the individual code. However, only those receivers with the same tone B or C active filters are grouped. A group call code (for a long tone group call) consists of three digits, but the second and third digits are the same. The first digit indicates the tone group from which the tone B or C is selected. The second and third digits determine the specific active filter selected from that group. A typical two call MINITOR II Alert Monitor Receiver with Long Tone B group call might be coded B465/255, the first number is the individual call code and the next number is the group call code. According to Table 4 and Table 3, the following active filters are installed in this receiver.

Tone A = Tone Code 116, Frequency 457.9 Hz
(Tone 6 of Group 1)

Tone B = Tone Code 125, Frequency 746.8 Hz
(Tone 5 of Group 2)

The group call "cap," (255) verifies that filter 5 of group 2 is used in the tone B position. The last digit of the individual call "cap" will always be the same as the second and third digits of the group call "cap" because of the tone B interrelationship noted above. Also, because of the group requirement for Long Tone tone B or C an additional restriction is applied to individual codes to be grouped. For long tone B group call, the first digit of the individual "cap" must indicate a tone B filter selection from the group shown by the first digit of the group call "cap". For instance, (B465/255) cannot be grouped with receiver B565 even though the last digits are the same. First digit 5, code type B, indicates a tone B selection from tone group 3 according to the code plan table. This unit cannot use group call code 255.

For Long Tone B group call, the maximum number of units that may be included in a group is equal to the total number of alerting tones available in the encoder, minus one. The maximum number of groups in a system is equal to the number of alerting tones available.

b. Dual Call

In this approach, two different two tone sequential calls are possible through the use of 3 tones installed in each pager. The first, second, and third tones in each unit are referred to as tone A, B, and C respectively. One of the three tones, either the A tone or B tone, is used in both two tone sequential addresses. Pagers using this type of group call are assigned two, three or four digit CAP CODE numbers.

Within this form of group call, two approaches, the common tone A or common tone B are possible. If the common tone A approach is selected, the pager is capable of decoding **both** A/B and A/C two tone call. If the common tone B approach is used, that same pager would respond to **both** A/B and C/B two tone calls.

In the following example the first address is the individual call code and the second address is the group call code.

The following tones are installed in our example pager:

Tone A-121
Tone B-122
Tone C-123

If the pager is equipped for common tone A operation, then the first call will be "cap" 212 (tone 121 in the A position and tone 122 in the B position) while the second call "cap" will be 213 (tone 121 in the A position and tone 123 in the C position).

If equipped for common tone B operation, then the first call would be 212 (tone 121 in the A position and tone 122 in the B position) while the second call "cap" will be 232 (tone 123 in the C position and tone 122 in the B position).

Under either approach, both "caps" will appear in the cap code window of the pager.

Table 5 shows the individual and group call capabilities for Long Tone B group call, option R138. The table shows the maximum number of individual calls, the maximum number of groups and the number of individual calls per group for the MODEN series encoders.

Table 6 illustrates the maximum group sizes possible through the combination of Common Tone A and Common Tone B Dual Options (R97 and R177).

Table 7 shows capability for three call capability, option R134 (A-B, Long Tone B, Long Tone C) and R362 (A-B, Long Tone C). Finally, Table 8 shows the capability for Four Call capability, option R468 (A-B, A-C, Long Tone B, Long Tone C) or R130 (A-B, A-C, Long C). For signalling variations such as this and for other situations that call for multiple call signalling, contact your Systems Engineering Group or Private Paging Marketing.

Table 1 General Encoding Plan

FIRST DIGIT OF PAGE CODE	GROUP FROM WHICH TONE A IS SELECTED	GROUP FROM WHICH TONE B IS SELECTED
1	1	1
2	2	2
3	1	2
4	4	4
5	5	5
6	2	1
7	4	5
8	5	4
9	2	4
0	4	2
A	3	3

Table 2 "Quik-Call" Tones
Code Type "Y" Tone Groups

TONE NO.*	A SERIES		B SERIES		Z SERIES	
	REED CODE	FREQ Hz	REED CODE	FREQ Hz	REED CODE	FREQ Hz
1	DA	398.1	DB	412.1	DZ	384.6
2	EA	441.6	EB	457.1	EZ	426.6
3	FA	489.8	FB	507.0	FZ	473.2
4	GA	543.3	GB	562.3	GZ	524.8
5	HA	602.6	HB	623.7	HZ	582.1
6	JA	668.3	JB	691.8	JZ	645.7
7	KA	741.3	KB	767.4	KZ	716.7
8	LA	822.2	LB	851.1	LZ	794.3
9	MA	912.0	MB	944.1	MZ	881.0
0	CA	358.9	CB	371.5	CZ	346.7

*2nd or 3rd digit of alert code.

Table 3. Tone Groups

** TONE NUMBER	TONE GROUP 1		TONE GROUP 2		TONE GROUP 3 (OR A)		TONE GROUP 4		TONE GROUP 5		TONE GROUP 6		TONE GROUP 10		TONE GROUP 11	
	CODE	FREQ Hz	CODE	FREQ Hz	CODE	FREQ Hz.	CODE	FREQ Hz	CODE	FREQ Hz	CODE	FREQ. Hz.	CODE	FREQ. Hz.	CODE	FREQ. Hz.
1	111	349.0	121	600.9	138	288.5	141	339.6	151	584.6	191	1153.4	170	1472.9	200*	1930.2
2	112	368.5	122	634.5	106	296.5	142	358.6	152	617.4	192	1185.2	171	1513.5	201*	1989.0
3	113	389.0	123	669.9	139	304.7	143	378.6	153	651.9	193	1217.8	172	1555.2	202*	2043.8
4	114	410.6	124	707.3	109	313.0	144	399.8	154	686.3	194	1251.4	173	1598.0	203*	2094.5
5	115	433.7	125	746.8	160	958.7	145	422.1	155	726.8	195	1285.8	174	1642.0	204*	2155.6
6	116	457.9	126	788.5	130	979.9	146	445.7	156	767.4	196	1321.2	175	1687.2	205*	2212.2
7	117	483.5	127	832.5	161	1006.9	147	470.5	157	810.2	197	1357.6	176*	1733.7	206	2271.7
8	118	510.5	128	879.0	131	1034.7	148	496.8	158	855.5	198	1395.0	177*	1781.5	207	2334.6
9	119	539.0	129	928.1	162	1063.2	149	524.6	159	903.2	199	1433.4	178*	1830.5	208	2401.0
0	110	330.5	120	569.1	189	1092.4	140	321.7	150	553.9	190	1122.5	179*	1881.0	209	2468.2

*Alert tone lock-up applies to pagers which utilize reeds (not active filters)
**Second or third digit of cap code.

Table 4. Code Plan Table

CODE TYPE	B		C		D		E		F		G		H		J		K		L		M		N		P		Q		R		S		T		U		V		W		Y	
TONE	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
FIRST DIGIT	TONE GROUPS SELECTED																																										
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	2	3	2	3	2	4	2	4	2	5	3	4	3	4	3	5	4	6	A	A
2	2	2	2	2	2	2	2	2	1	3	1	3	1	3	1	4	1	4	1	5	2	2	2	2	2	2	2	2	2	2	2	2	4	3	4	3	5	3	6	4	B	B
3	3	3	1	2	1	2	1	2	3	3	3	3	3	3	4	1	4	1	5	1	3	3	3	3	3	3	4	2	4	2	5	2	3	3	3	3	3	3	5	6	Z	Z
4	1	2	4	4	1	5	2	1	4	4	3	1	3	1	4	4	4	4	1	6	4	4	3	2	3	2	4	4	4	4	2	6	4	4	4	4	3	6	4	4	A	B
5	1	3	1	4	5	5	1	6	3	1	5	5	1	6	5	5	1	6	5	5	3	2	5	5	2	6	5	5	2	6	5	5	5	5	3	6	5	5	5	5	A	Z
6	2	1	2	1	2	1	6	6	1	4	1	5	6	6	1	5	6	6	6	6	2	4	2	5	6	6	2	5	6	6	6	6	3	5	6	6	6	6	6	6	B	A
7	3	1	4	1	5	1	6	1	4	1	5	1	6	1	4	5	6	1	6	1	4	2	5	2	6	2	4	5	6	2	6	2	4	5	6	3	6	3	4	5	Z	A
8	2	3	2	4	2	5	2	6	3	4	3	5	3	6	5	4	4	6	5	6	3	4	3	5	3	6	5	4	4	6	5	6	5	4	4	6	5	6	5	4	B	Z
9	3	2	4	2	5	2	6	2	4	3	5	3	6	3	5	1	6	4	6	5	4	3	5	3	6	3	5	2	6	4	6	5	5	3	6	4	6	5	6	5	Z	B
0	2	4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4	2	4	2	X	X	X	X	4	2	4	2	4	2	4	2	X	X		

X=Not Used

TABLE 5

Systems Utilizing
Long Tone B Group Call Option, R138
Standard on PEOPLE FINDER. Requires no option.

Encoder	CENTRACOM SERIES II	MODEN 900 (30 tones)	MODEN 100 (10 tones)	MODEN 36 (6 tones)	People Finder (30 tones)
Maximum number of individual calls	6806	870	90	30	399
Maximum number of groups	83	30	10	6	10*
Maximum number of individuals in a group	82	29	9	5	9*

*Additional capacity for group call may be available for some code plans. Consult the paging Systems Product Group for further information.

TABLE 6

Systems Utilizing a Combination of Common Tone A & Common Tone B* Dual Call Options R97 and R177

Standard on PEOPLE FINDER. Requires no option.

Encoder	MODEN 900(30 tones)		MODEN 100(10 tones)		MODEN 36(6 tones)		People Finder(30 tones)	
Maximum number of individual calls	842		82		26		399	
Maximum number of groups	28		8		4		8	
	Maximum number of groups	Number of individuals per group	Maximum number of groups	Number of individuals per group	Maximum number of groups	Number of individuals per group	Maximum number of groups	Number of individuals per group
	2 with	56 or	2 with	16 or	2 with	8 or	Variable depending on the code plan.**	
	4 with	52 or	4 with	12 or	2 with	4		
	6 with	48 or	6 with	8 or				
	8 with	44 or	8 with	4				
	10 with	40 or						
	12 with	36 or						
	14 with	32 or						
	16 with	28 or						
	18 with	24 or						
	20 with	20 or						
	22 with	16 or						
	24 with	12 or						
	26 with	8 or						
	28 with	4						

*When combining common tone A and common tone B, contact your Systems Engineering Group or Private Paging Product Group.

**Consult the Paging Systems Product Group for further information.

TABLE 7

Systems Utilizing A-B, Long B, Long C (Option R134) One All Call with Multiple Subgroups

Standard on PEOPLE FINDER. Requires no option.

Encoder	CENTRACOM SERIES II (83 tones)	MODEN PLUS OR MODEN 900 (30 tones)	MODEN 100 (10 tones)	MODEN 36 (6 tones)
Maximum number of individual calls in all call (Long Tone C)	6642	812	72	20
Maximum number of subgroups (Long Tone B)	82	29	9	5
Maximum number of individuals per Long Tone B subgroup	81	28	8	4

Note: 1. Long Tone C cannot be used with Alert Central Encoder.

2. Table can also be used for Option R662 (A-B, Long Tone C), but Long Tone B Group References do not apply.

People Finder's maximum number of groups, subgroups and individuals in each of the above configurations is variabe depending on the code plan. Consult the Paging Systems Product Group for further information.

TABLE 8

Systems Utilizing Four Call Receivers with Option R468 (A-B, A-C, Long Tone B, Long Tone C) One Individual and Three Group Calls Only One Long Tone C Group

Standard on PEOPLE FINDER. Requires no option.

Encoder	CENTRACOM SERIES II (83 tones)	MODEN PLUS OR MODEN 900 (30 tones)	MODEN 100 (10 tones)	MODEN 36 (6 tones)
Maximum number of total individuals	6723	840	80	24
Maximum number of A-C Groups	83	30	10	6
Maximum number of individuals in A-C Group	81	28	8	4
Maximum number of Long Tone B Groups	82	29	9	5
Maximum number of individuals in Long Tone B Group	82*	29*	9*	5*
Maximum number of individuals in one Long Tone C Group	6642	812	72	20

This table also applies to Option R130 A-B, A-C, Long Tone C except the references to Long Tone B Groups.
*Maximum number of individuals in one of the Long Tone B group is one less than the number stated.

People Finder's maximum number of groups. subgroups and individuals in each of the above configurations is variabe depending on the code plan. Consult the Paging Systems Product Group for further information.

TABLE 9
Alert Option Tone Sets

Option Configuration	Call Format	Alert Tone Pattern
None Standard Model	A-B	Interupted alert
R97	A-B A-C	Interupted alert Continuous alert
R177	A-B C-B	Interupted alert Interupted alert
R138	A-B Long Tone B	Interupted alert Continuous alert
R362	A-B Long Tone C	Interupted alert Continuous alert
R130	A-B A-C Long Tone C	Interupted alert Continuous alert Continuous alert
R60	A-B C-B Long Tone B	Interupted alert Interupted alert Continuous alert
R134	A-B Long Tone B Long Tone C	Interupted alert Continuous alert Continuous alert
R468	A-B A-C Long Tone B Long Tone C	Interupted alert Interupted alert Continuous alert Continuous alert

The following is a listing supplied by the coding department in Schaumburg, Illinois, of all standard Motorola and competitive tones available for use in two-tone sequential and PRIVATE-LINE squelch alerting systems. For easy reference, the competitive tones and/or tone codes are listed along with the available Motorola tones and tone codes. The available tones are listed sequentially by Hz. For tones not listed, contact Paging Marketing for availability.

HZ	EIA CODE	MOTOROLA CODE/TONE	BRAMCO CODE	COMEX CODE	GE TONE NO.	FEDERAL	PLECTRON	BELL & HOWELL
67.0	L1	XZ	L1					
69.3		WZ						
71.9	L2	XA	L2					
74.4		WA						
77.0	L3	XB	L3					
79.7		WB						
82.5	L4	YZ	L4					
85.4		YA						
88.5	L4A	YB	L4A					
91.5		ZZ						
94.8	L5	ZA	L5					
97.4		ZB						
100.0	1	1Z	1					
103.5	1A	1A	1A					
107.2	1B	1B	1B					
110.9	2	2Z	2					
114.8	2A	2A	2A					
118.8	2B	2B	2B					
123.0	3	3Z	3					
127.3	3A	3A	3A					
131.8	3B	3B	3B					
136.5	4	4Z	4					
141.3	4A	4A	4A					
146.2	4B	4B	4B					
151.4	5	5Z	5					
156.7	5A	5A	5A					
162.2	5B	5B	5B					
167.9	6	6Z	6					
173.8	6A	6A	6A					
179.9	6B	6B	6B					
186.2	7	7Z	7					
192.8	7A	7A	7A					
202.7		101						
203.5	M1	203.5	M1					
206.5		8Z						
210.7	M2	210.7	M2					
218.1	M3	218.1	M3					
225.7	M4	225.7	M4					
229.1		9Z						
233.6	M5	233.6	M5					
241.8	M6	241.8	M6					
244.7							(P39)	
250.3	M7	250.3	M7					
254.1		254.1						
258.8	136		136					
266.0	106		106					
273.3	137		137					
280.8	107		107					
281.8		AZ						
282.2							(P38)	
288.5	138	138	138	288.5				138
296.5	108	108	108	296.5				108

HZ	EIA CODE	MOTOROLA CODE/TONE	BRAMCO CODE	COMEX CODE	GE TONE NO.	FEDERAL	PLECTRON	BELL & HOWELL
304.7	139	139	139	304.7				139
307.8							(P40)	
312.6		BZ						
313.0	109	109	109	313.0				109
321.4							(P41)	
321.7	140	140	140	321.7				140
330.5	110	110	110	330.5				110
335.6							(P42)	
339.6	141	141	141	339.6				141
346.7		CZ						
349.0	111	111	111	349.0				111
350.5							(P43)	
358.6	142	142	142	358.6				142
358.9		CA						
366.0							(P44)	
368.5	112	112	112	368.5				112
371.5		CB						
378.6	143	143	143	378.6				143
382.3							(P45)	
384.6		DZ						
389.0	113	113	113	389.0				113
398.1		DA						
399.2							(P46)	
399.8	144	144	144	399.8				144
410.8	114	114	114	410.8				114
412.1		DB						
416.9							(P47)	
422.1	145	145	145	422.1				145
426.6		EZ						
433.7	115	115	115	433.7				115
435.3							(P48)	
441.6		EA						
445.7	146	146	146	445.7				146
454.6							(P49)	
457.1		EB						
457.5		44 (GE)			457.5			
457.9	116	116	116	457.9				116
470.5	147	147	147	470.5				147
472.5		43 (GE)			472.5			
473.2		FZ						
474.8							(P50)	
483.5	117	117	117	483.5				117
487.5		42 (GE)			487.5			
489.8		FA						
495.8							(P51)	
496.8	148	148	148	496.8				148
502.5		41 (GE)			502.5			
507.0		FB						
510.5	118	118	118	510.5				118
517.5		1 (GE)			517.5			
517.8							(P52)	
524.6	149	149	149	524.6				149
524.8		GZ						
532.5		2 (GE)			532.5			
539.0	119	119	119	539.0				119
540.7							(P53)	
543.3		GA						
547.5		3 (GE)		547.5	547.5			
553.9	150	150	150	553.9				150

HZ	EIA CODE	MOTOROLA CODE/TONE	BRAMCO CODE	COMEX CODE	GE TONE NO.	FEDERAL	PLECTRON	BELL & HOWELL
562.3		GB						
562.5		4 (GE)			562.5			
564.7							(P54)	
569.1	120	120	120	569.1				120
577.5		5 (GE)			577.5			
582.1	H	HZ	H					
584.8		151		584.8				151
589.7							(P55)	
592.5		6 (GE)		592.5	592.5			
600.9	121	121	121	600.9				121
602.6		HA						
607.5		7 (GE)			607.5			
615.8							(P56)	
617.4	152	152	152	617.4				152
622.5		8 (GE)			622.5			
623.7		HB						
625.0		*						
634.5	122	122	122	634.5				122
637.5		9 (GE)		637.5	637.5			
643.0						(F1) 643.0	(P1) 643.0	
645.7		JZ						
651.9	153	153	153	651.9				153
652.5		10 (GE)			652.5			
667.5		11 (GE)			667.5			
668.3		JA						
669.9	123	123	123	669.9				123
672.0							(P2) 672.0	
682.5		12 (GE)		682.5	682.5			
688.3	154	154	154	688.3				154
691.8		JB						
692.0						(F2) 692.9		
697.5		13 (GE)			697.5			
701.0							(P3) 701.0	
707.3	124	124	124	707.3				124
712.5		14 (GE)			712.5			
716.1		KZ						
726.8	155	155	155	726.8				155
727.5		15 (GE)		727.5	727.5			
732.0							(P4) 732.0	
735.0		*						
741.3		KA						
742.5		16 (GE)			742.5			
746.8	125	125	125	746.8				125
749.0						(F3) 749.0		
757.5		17 (GE)		757.5	757.5			
765.0							(P5) 765.0	
767.4	156	156/KB	156	767.4				156
772.5		18 (GE)			772.5			
787.5		19 (GE)			787.5			
788.5	126	126	126	788.5				126
794.3		LZ						
799.0							(P6) 799.0	
802.5		20 (GE)		802.5	802.5			
810.0						(F4) 810.0		
810.2	157	157	157	810.2				157
817.5		21 (GE)			817.5			
822.2		LA						
825.0		*						
832.5	127	127/22 (GE)	127	832.5	832.5			127

TONE (HZ)	EIA CODE	MOTOROLA CODE/TONE	BRAMCO CODE	COMEX CODE	GE TONE NO	FEDERAL	PLECTRON	BELL HOW
834.0							(P7) 834.0	
847.5		23 (GE)		847.5	847.5			
851.1		LB						
855.5	158	158	158	855.5				158
862.5		24 (GE)			862.5			
871.0							(P8) 871.0	
877.0						(F5) 877.0		
877.5		25 (GE)			877.5			
879.0	128	128	128	879.0				128
881.0		MZ						
892.5		26 (GE)		892.5	892.5			
900.0		*						
903.2	159	159	159	903.2				159
907.5		27 (GE)			907.5			
910.0							(P9) 910.0	
912.0		MA						
922.5		28 (GE)			922.5			
928.1	129	129	129	928.1				129
937.5		29 (GE)		937.5	937.5			
944.1		MB						
949.0						(F6) 949.0		
950.0							(P10) 950.0	
952.5		30 (GE)			952.5			
953.7	160	160	160	953.7				160
967.5		31 (GE)			967.5			
977.2		NZ						
979.9	130	130	130	979.9				130
980.0		*						
982.5		32 (GE)			982.5			
992.0							(P11) 992.0	
997.5		33 (GE)			997.5			
1006.9	161	161	161	1006.9				161
1011.6		NA						
1012.5		34 (GE)			1012.5			
1026.0						(F7) 1026.0		
1027.5		35 (GE)			1027.5			
1034.7	131	131		1034.7				131
1036.0							(P12) 1036.0	
1042.5		36 (GE)			1042.5			
1047.1		NB						
1057.5		37 (GE)			1057.5			
1063.2		162		1063.2				162
1070.0		*						
1077.5		38 (GE)			1077.5			
1082.0							(P13) 1082.0	
1084.0	P	PZ	P					
1087.5		39 (GE)			1087.5			
1092.4	189	189		1092.4				189
1102.5		40 (GE)			1102.5			
1110.0						(F8) 1110.0		
1117.5		45 (GE)			1117.5			
1120.0	S11		S11					
1122.1		PA						
1122.5	190	190						190
1130.0							(P14) 1130.0	
1132.5		46 (GE)			1132.5			
1147.5		47 (GE)			1147.5			
1153.4	191	191						191
1161.4		PB						
1162.5		48 (GE)			1162.5			
1170.0		*						

TONE (HZ)	EIA CODE	MOTOROLA CODE/TONE	BRAMCO CODE	COMEX CODE	GE TONE NO	FEDERAL	PLECTRON	BELL & HOWELL
1177.5		49 (GE)			1177.5			
1180.0							(P15) 1180.0	
1185.2		192						192
1190.0	S12		S12					
1192.5		50 (GE)			1192.5			
1201.0						(F9) 1201.0		
1207.5		51 (GE)			1207.5			
1217.8		193						193
1220.0	S2		S2					
1232.0							(P16) 1232.0	
1251.4		194						194
1265.0	S14		S14					
1280.0		*						
1285.8		195						195
1287.0							(P17) 1287.0	
1291.4	S3		S3					
1299.0						(F10) 1299.0		
1320.0	S15		S15					
1321.2		196						196
1344.0							(P18) 1344.0	
1355.0	S16		S16					
1357.6		197						197
1395.0		198						198
1400.0	S17	*	S17					
1403.0							(P19) 1403.0	
1405.0						(F11) 1405.0		
1430.5	S7		S7					
1433.4		199						199
1450.0	S18		S18					
1465.0							(P20) 1465.0	
1472.9		170						170
1500.0	S20	S20	S20					
1513.5		171						171
1520.0	S9	*	S9			(F12) 1520.0		
1530.0							(P21) 1530.0	
1550.0	S21	CQ	S21					
1555.2		172						172
1598.0		173					(P22) 1598.0	173
1600.0	S22	S22	S22					
1642.0		174						174
1650.0		*						
1669.0							(P23) 1669.0	
1687.2		175						175
1695.0						(F13) 1695.0		
1733.7		176						176
1743.0							(P24) 1743.0	
1780.0						(F14) 1780.0		
1781.5		177						177
1800.0		*						
1820.0							(P25) 1820.0	
1830.5		178						178
1881.0		179						179
1901.0							(P26) 1901.0	
1926.0						(F15) 1926.0		
1930.2		200						200
1950.0		*						
1985.0							(P27) 1985.0	
1989.1		201						201
2043.8		202						202
2073.0							(P28) 2073.0	
2084.0						(F16) 2084.0		

TONE (HZ)	EIA CODE	MOTOROLA CODE/TONE	BRAMCO CODE	COMEX CODE	GE TONE NO.	FEDERAL	PLECTRON	BELL & HOWELL
2094.5		203						203
2100.0		*						
2155.6		204						204
2164.0							(P29) 2164.0	
2212.2		205						205
2250.0		*						
2255.0						(F17) 2255.0		
2260.0							(P30) 2260.0	
2271.7		206						206
2334.6		207						207
2361.0							(P31) 2361.0	
2400.0		*						
2401.0		208						208
2440.0						(F18) 2440.0		
2465.0							(P32) 2465.0	
2468.2		209						209
2575.0							(P33) 2575.0	
2610.0		*						
2640.0						(F19) 2640.0		
2688.0							(P34) 2688.0	
2807.0							(P35) 2807.0	
2840.0		*						
2856.0						(F20) 2856.0		
2932.0							(P36) 2932.0	
3062.0							(P37) 3062.0	

* These tones correspond to a code plan which no longer exists. Contact Private Paging Marketing in Boynton Beach, Florida regarding availability of these tone filters.

NOTE 1

When ordering pagers requiring Active Filters (PAGEBOY III, DIMENSION IV, SPIRIT, and MINITOR) GE tones above 682.5 Hz cannot be ordered due to the inadequate spacing of tones in the GE code plan. However, this same incompatibility does not exist when ordering GE tones in reed type radios. Therefore, you may order any GE tone on Standard MINITOR Alert Monitor Receivers.

NOTE 2

When ordering Federal and Plectron tones for the Dual Call three tone MINITOR Alert Monitor Receivers and the Minitor II Alert Monitor Receivers, order by the code number shown in the parenthesis on the above pages. Example: Plectron tone 643.0 Hz should be ordered by its code number which is P1. When ordering Plectron or Federal tones for all standard PAGECOM, DIRECTOR, or MINITOR pagers, order by the Hz shown. Example: Plectron tone 643.0 Hz should be ordered as 643.0 Hz.

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